PROCESSING FOR RELEVANCE:

A PRAGMATICALLY BASED ACCOUNT OF HOW WE PROCESS NATURAL LANGUAGE.

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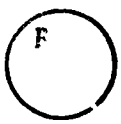

ABSTRACT

This thesis presents an account of some of the mental mechanisms and processes that take the addressee from a linguistic input to the interpretation of that input. Because on-line interpretation involves our knowledge of language, the relation between input processing and grammar is evaluated. The full interpretation of a linguistic input also involves pragmatic, i.e. central cognitive processes, but these processes are the least well understood within psycholinguistics.

Relevance theory (Sperber & Wilson, 1986) gives us a way of making our understanding of these processes more explicit. However, Relevance theory claims turn out to be incompatible with psycholinguistic models which postulate an autonomous syntactic parser, such as the 'Garden-path' model. A review of the experimental literature reveals that the findings claimed to support the 'Garden-path' model do not in fact support it. Likewise, the principle of Lexical Preference, proposed to account for how verb subcategorization frames are accessed, turns out not to be supported by the experimental evidence.

Full interpretation involves computing a conceptual representation, and an account is given of what constitutes conceptual structure. This leads to the proposal that verbs are represented as structured concepts. This view of verb representation together with Relevance theory can account for when arguments of verbs can be left implicit.

Finally, an account is given of how the addressee computes the propositional form communicated by an utterance, by building hypotheses about the conceptual structure of the proposition on-line. These hypotheses are based on structural information stored under the concepts referred to by the utterance. This proposal can account for psycholinguistic research findings, with pragmatics playing an integral role in the explanations: it is no longer grafted onto the model as a psycholinguistic afterthought.

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Introduction.

This thesis grew out of my interest in the question of whether Relevance theory has implications for a psycholinguistic model of sentence input processing. A theory of the comprehension process should account for how people compute the full pragmatic meaning of an utterance, but there is, as yet, little psycholinguistic theorisation of pragmatic aspects of interpretation. Because Relevance theory makes explicit claims about how natural language is interpreted in real time, and gives an explanation of how processes such as disambiguation and reference assignment can be accounted for, it should have consequences for a psycholinguistic model of processing.

In Chapter 1, I review the relation between input processing and grammar, as it has been interpreted by many psycholinguists. Because in much psycholinguistic work it has been assumed that underlying on-line processing there is a modular 'language faculty', as proposed by Fodor (1983), I address the question of whether his proposals are supported by independent evidence. I go on to to look at the relation between the linguistic input and central cognitive processes, and introduce Relevance theory. I then give a first assessment of what the consequences of Relevance theory are for a psycholinguistic model of input processing.

Because the predictions of Relevance theory are at odds with models of input processing which assume an autonomous parser, I evaluate the experimental evidence claimed to support this type of model in Chapter 2, and argue that the findings do not in fact support this model. Some of these findings can be reinterpreted if we assume that verb subcategorization information (of some sort) is used to analyse the linguistic input. In chapter 3, I look at different proposals concerning how verb subcategorization information is used in on-line processing. I evaluate experimental findings which are said to support the Principle of Lexical Preference, proposed to account for how addressees access and use verb subcategorization. We find that this principle is not supported by the experimental findings.

In Chapter 4, I look at Relevance theory proposals concerning on-line sentence processing, and point out a number of problems these proposals face. To understand how we compute the full pragmatic interpretation of an utterance, we have to have a better insight in what constitutes conceptual structure. To this end, I look at proposals made by Jackendoff (1983) and Pinker (1989), and propose an

account of what constitutes conceptual structure, showing that verbs are represented as structured concepts. This view of verb representation together with Relevance theory gives us an account for when arguments of verbs can be left implicit.

In Chapter 5, I propose an account of sentence processing which shows how the addressee computes the propositional form communicated by an utterance by building hypotheses about the propositional form on-line, in accordance with the principle of Relevance. I show how this proposal gives us a better insight in what constitutes 'processing effort'. The model can account for experimental findings concerning structural ambiguity and 'garden-path' sentences. Moreover, it explains why some multiple centre-embedded sentences are difficult to process, and gives an alternative view of how 'fillers' are associated with their 'gaps' in sentences with long distance dependencies.

To conclude I re-evaluate the relation between the grammar, conceptual structure and on-line processing.

Chapter 1: Theoretical considerations.

The psycholinguistic study of comprehension tries to account for the mental mechanisms and processes that take the addressee from a linguistic input to the interpretation of that input. In order to understand these mechanisms and processes, psycholinguists can conduct psychological experiments to gather data, and develop a theoretical framework against which to evaluate experimental findings.

Because interpretation involves interaction with general cognitive processes at some stage, an explanatory theory of comprehension should account for its place within a theory of cognition. Moreover, because comprehension involves our knowledge of language, an explanatory theory of comprehension should account for its relation to linguistic theory. Tanenhaus, Carlson & Seidenberg (1985) put forward two possible views of the relationship between the grammar and the general cognitive system, which make different predictions for the relationship between the grammar and how addressees process sentences. The first view, the Chomskyan view, is that the grammar is a cognitive subsystem which accounts for the structure of language, whose vocabulary and operations are defined independently of the general cognitive system (cf. Chomsky, 1980a). On this view, linguistics explains the structure of language. The second view is that the structure of language is explained by basic principles of the general cognitive system, for example, the nature of concepts in interaction with basic properties of the human information processing system. On this view, linguistics describes the structure of language, but does not explain it.

Tanenhaus et al. suggest that these two views of linguistics point to different research strategies concerning the grammar and the interpretation process. On the first view, the view that the linguistic system is primary, the question is how linguistic representations as defined by the grammar are recovered from a perceptual input during comprehension. This raises questions such as whether the rules of grammar are actually realized as processing operations. On the second view, which proposes that the general cognitive system is basic, the focus of research shifts to questions concerning the operation and organization of the cognitive system. Properly understood, the structure of language would fall out as a consequence of the structure of the cognitive system itself. (Tanenhaus et al., 1985, pp. 359-360).

In the literature many researchers have argued against the second view. For example, Carston (1986) says that:

> *"The fallout view faces strong disconfirming evidence in the detailed and very complex knowledge of language which investigations by Chomsky and his colleagues have shown very young children to have."* (Carston, 1988, p.41).

The question is whether this means that one has to opt for the first view put forward by Tanenhaus et al., the view that the constructs of linguistic theory are both mental and primitive. As Tanenhaus et al. point out, there are different versions of the 'linguistics as description' view. Apart from the extreme version, which states that constructs of linguistic theory do not play a serious role in language acquisition and use, one can take the position that grammars are mental entities without claiming that the constructs of linguistic theory are mental primitives. On this view, one can seek to explain how linguistic constructs are derived from other mental properties. A further possible position is the view that some linguistic constructs are mental primitives, without committing oneself to the view that the grammar as a whole, as defined by linguists, is a cognitive subsystem independent of the general cognitive system. On this view, the question which linguistic constructs are mental primitives becomes a matter of theoretically motivated investigation, rather than a matter of a priori belief.

However, rejecting the 'fallout view' has lead many psycholinguists to embrace the first view of the relationship between the grammar and the general cognitive system. This has had some important consequences for the way in which psycholinguists have studied language processing and acquisition. The view of the grammar as constituting an independent 'language faculty' has influenced the way in which psycholinguists have thought of the organization of models of comprehension. As Frazier, Clifton & Randall (1983) say:

> *"The claim that there are distinct components in our linguistic knowledge permits (though it does not dictate) the claim that there are corresponding components in our language comprehension mechanism, and that these components operate at different points in time in the comprehension of a sentence."* (Frazier et al., 1983, p. 218).

Although Frazier et al. qualify their statement by saying that it is not necessarily the case that the structure of the grammar is reflected in the structure of the language processor, in practice it is generally assumed that the different components of the grammar, phonology, syntax and semantics, correspond to components of the language processor, i.e. a word-level processor, a syntactic processor and a message-level processor (e.g., cf. Forster, 1979). Moreover, this view of the

relationship between grammar and parser, has encouraged psycholinguists to assume that the different components operate in a serial fashion, i.e. that the analysis of the input by one component has to be completed before analysis by another component can commence. This means that the information flow among different components of the processor is one-way, from the bottom up. Chomsky's proposal that syntactic concepts should be defined without reference to pragmatic, phonological or semantic information, has encouraged psycholinguists to assume that the different components of the language processor operate autonomously. This has given rise to 'autonomous' models of processing, in which the sub-processors can only make use of information contained within themselves to conduct an analysis of the input.

Furthermore, the claim of Chomskyan linguistics that the grammar is 'psychologically real', has given rise to the assumption that rules and representations as proposed by the grammar should be borne out by experimental evidence. As Black & Chiat (1981) point out:

> *"Psycholinguistics has seen itself as a testing-ground for linguistic theories. It has been dominated by attempts to find 'evidence' for components of the grammar."* (Black & Chiat, 1981, p.45).

A problem with this is that without an explanatory psycholinguistic theory against which data can be evaluated, we cannot be sure what the data actually tell us. This means that purported 'evidence' for or against a particular grammar does not necessarily advance our understanding of psycholinguistic processes and mechanisms. Moreover, by assuming that the grammar is the backbone of a psycholinguistic theory, it seems that developing such a theory will only be feasible when it has been ascertained which of the many (changing) grammars proposed by linguists correctly represents the mental grammar.

In the next section, we will look at some psycholinguistic research and proposals that have been concerned with the relation between the grammar and on-line sentence comprehension.

1.1. The grammar and sentence processing.

Inspired by Chomsky's (1957) 'Syntactic structures', psycholinguistic research in the 1960's set out to test whether the grammar could be taken as a model for language processing, which gave rise to the Derivational Theory of Complexity (DTC). The DTC posits that the

language processor uses the rules of the grammar directly in the interpretation process. Since the then current view of the grammar was that the surface structure of a sentence is related to a deep structure by some number of transformations, the hypothesis was that the processing complexity of a sentence is dependent on the number of transformations needed to derive the deep structure of the sentence from its surface structure. Although early experiments seemed to comply with the DTC, the hypothesis was abandoned after a range of experiments failed to bear out the predictions made by the DTC (cf. Fodor, Bever & Garret, 1974). When it was found that there were alternative explanations possible for the experimental evidence, based on semantics, it was concluded that processing complexity cannot be explained solely in terms of syntactic complexity.

After the demise of the DTC, much psycholinguistic research shifted to semantically based accounts (e.g. Schank, 1972), and the search for heuristic strategies to account for the comprehension process (e.g. Fodor, Garrett & Bever, 1968; Bever, 1970). The latter program was based on the view that the processor computes linguistic representations, but uses heuristics, rather than rules of the grammar, in doing so. The use of these heuristic strategies should explain findings of processing complexity and difficulty, which were not predicted by the grammar. However, the strategies proposed were *ad hoc*, and did not give any theoretically based explanation of how the language processing system is organized or operates.

The importance of such an explanation was first considered by Kimball (1973). Kimball argued that, in order to explain processing complexity, we have to look for a theory of how the language processor computes the surface structure of a sentence. He suggested that the processor makes use of grammatical rules, i.e. phrase structure rules. However, the way in which it uses these rules is governed by seven specific parsing principles. These principles constitute a coherent whole, intended to explain why sentences get assigned the surface structure that they do. Frazier & Fodor (1978) developed Kimball's proposal into "the sausage machine", a two-stage parser which operates using one parsing principle. In turn this model has developed into the 'garden-path' model (e.g. Frazier, 1987a,b,c; Ferreira & Clifton, 1986; Rayner, Carlson & Frazier, 1983). The 'garden-path' model postulates that the parser computes a single structural analysis guided by two parsing principles, the principle of Minimal Attachment, which says that "*one does not postulate any (potentially) unnecessary nodes*",

and the principle of Late Closure, which says that "*if grammatically permissible, new nodes are attached into the clause or phrase currently being processed (i.e. the phrase or clause postulated most recently)*" (Frazier, 1987a, p.562). This model predicts that in the case of (1.1), the VP is analyzed as (1.1a) rather than (1.1b), because the analysis in (1a) contains fewer nodes:

1.1. John hit the man with the stick.
  a. John ((hit)(the man)(with the stick)).
  b. John ((hit)((the man)(with the stick))).

A problem with this proposal is that it presupposes that the phrase structure rules used by the parser contain only categories of the types X (e.g. N, V, P) and XP (e.g. NP, VP, PP). When one assumes richer phrase structure rules, such as proposed in X'-theory, the two parsing principles will make different predictions concerning the initial analysis of a sentence that the parser will go for. For example, on an X' analysis, the two readings of (1.1) have the same number of nodes, so that the principle of Minimal Attachment would not apply, and instead the principle of Late Closure would predict that the reading in (1.1b) would be computed.

The main claims of the 'garden-path' model are, that syntactic processing is autonomous, i.e. that it cannot make use of semantic and/or contextual information; and that a single syntactic representation is computed. We can ask whether these claims are borne out by the experimental evidence.

Marslen-Wilson & Tyler (1980) present some experiments which they conducted to track the availability of different types of processing information as these become available on-line. Subjects were asked to monitor for a target word in three types of prose material, as in (1.2):

1.2a. Normal prose.
The church was broken into last night.
The thieves stole most of the *lead* off the roof.

b. Syntactic prose.
The power was located in great water.
No buns puzzle some in the *lead* off the text.

c. Random word-order.
In was power water the great located.
Some the no puzzle buns in *lead* text the off.

Normal prose materials were normal sentences which can be analyzed both syntactically and semantically. Syntactic prose materials were syntactically well-formed, but were semantically anomalous. Random word-order materials were both syntactically and semantically ill-formed. All test materials were presented with or without a lead-in sentence (the first sentence in each condition in (1.2)), and each test sentence contained a target word (e.g. *lead* in (1.2)), whose position in the test sentence was varied. Marslen-Wilson & Tyler argue that by measuring the monitoring response times at different serial positions in the test sentences, one can determine the time course with which syntactic and semantic processing information becomes available. Furthermore, by comparing response times for the test sentences with and without a lead-in sentence, it can be established whether discourse context affects this time course.

Marslen-Wilson & Tyler found that for the test sentences with a lead-in sentence, response times for Normal prose were significantly faster than for the two other conditions, even at the very beginning of the test sentence: at the beginning of the test sentence Normal prose sentences are responded to about 50 msecs. faster than Syntactic prose sentences, and this remains the same over the whole sentence. When there is no lead-in sentence present, Normal prose sentences are responded to only marginally faster than the other two conditions, although this becomes significant later in the sentence. Syntactic prose sentences, on the other hand, are not significantly faster than Random word-order sentences at the beginning of the sentence, either with or without a lead-in sentence. Later on in the sentence Syntactic prose sentences are responded to significantly faster than Random word-order sentences, although this is still significantly slower than Normal prose response times. Marlsen-Wilson & Tyler argue that:

> *"These results show that the semantic dimensions of processing are dominant throughout a sentence, and that they have a significant effect on monitoring response even at the very beginning of the test-sentence, where the syntactic dimension has only a marginal effect."* (Marslen-Wilson & Tyler, 1980, p. 41).

Furthermore, because of the difference in response for the Normal prose sentences with and without a lead-in sentence, Marslen-Wilson & Tyler conclude that contextual information is used by the processor without any time lag in analyzing the input.

Tyler & Warren (1987) present some experiments which were conducted to see how listeners use the global and local structural organization of an utterance in the process of language comprehension. The first experiment was set up to test the structural implications of local and global variables, independent of the meaning of the utterance. Because of this sentences were made up which were meaningless, but syntactically well-formed (globally and/or locally). Subjects were asked to monitor for a target word. Sentences were made up in five conditions, as in (1.3):

1.3a. Early target (syntactically well-formed)
A SLOW KITCHEN/ was loudly watching/ the house/ because an orange dream/ snored/ with crashing leaves.

b. Late target (syntactically well-formed)
An orange dream/ was loudly watching/ the house/ during smelly lights/ because within these signs/ A SLOW KITCHEN/ snored/ with crashing leaves.

c. Scrambled (global syntactic disruption)
Because within these signs/ during smelly lights/ was loudly watching/ the house/ an orange dream/ A SLOW KITCHEN/ snored/ with crashing leaves.

d. Syntactic disruption (local)
An orange dream/ was loudly watching/ the house/ during smelly lights/ because within these signs/ SLOW VERY KITCHEN/ snored/ with crashing leaves.

e. Phonological disruption
An orange dream/ was loudly watching/ the house/ during smelly lights/ because within these signs/ A SLOW // KITCHEN IN MIST/ snored/ with crashing leaves.

Because of the finding of Marslen-Wilson & Tyler (1980), discussed above, that target words are responded to faster late in the sentence than early in the sentence, Tyler & Warren included an Early and a Late condition. Target words in the other three conditions were positioned in the same place as in the Late condition. To test the relevance of the global structure of an utterance, constituent phonological phrases were scrambled in the Scrambled condition. In the Syntactic disruption condition, the importance of local (within constituent) structure for processing was tested, by inserting an adverb between the adjective and the target noun, while in the Phonological disruption

condition, a local prosodic disruption was created by inserting a pause immediately before the target noun (denoted by // in (1.3)).

Tyler & Warren found that, as expected, response times in the Late condition were significantly faster than response times in the Early condition. However, they found that response times in the Scrambled condition were not significantly slower than those in the Late condition (while targets occurred in the same position in the sentence). This result cannot be explained if one assumes that the processor computes the global syntactic structure of an utterance, because then one would expect that the absence of such a structure would significantly slow down response times. On the other hand, Tyler & Warren did find that disruption of the local syntactic structure (the Syntactic disruption condition) did significantly slow down response times as compared to the Late condition, as did response times in the Phonological disruption condition, as compared to the Late condition. According to Tyler & Warren, this suggests that:

> *"... when listeners process an utterance which is not meaningful, the representation which they develop is based on local phrases, perhaps defined both prosodically and syntactically, as were the local phrases in the present study. There is no evidence from these data that the listener's representation spans anything larger than a local phrase, and therefore no evidence that listeners construct a syntactic representation consisting of the hierarchical organization of local phrases."* (Tyler & Warren, 1987, pp. 646-647).

In their second experiment, Tyler & Warren compare response times for anomalous prose (as in the first experiment) with response times for normal prose (syntactically and semantically well-formed sentences). Again they compare five conditions: Anomalous Late, Normal Late, (Normal) Scrambled, (Normal) Syntactic disruption, and (Normal) Phonological disruption.

Tyler & Warren got the following results:

Mean monitoring RT (msecs)

Anomalous Late	363
Normal Late	313
Scrambled	339
Syntactic disruption	427
Phonological disruption	385

As was expected, the difference in response time between the Anomalous Late condition and the Normal Late condition is significant. The difference between the Normal Late and Scrambled conditions, of 26 msecs. is not significant on the Newman-Keuls analysis, although it is

significant on both item and subject analyses. Tyler & Warren suggest that this may be partly due to the disruption of the semantic global organization of an utterance. What we see, furthermore, is that violations of local structure have a much larger effect on response times than violations of global structure. Tyler & Warren note that although the global structural organization in the sentences in the Scrambled condition is disrupted, these sentences do have a normal global prosodic structure. It could be the case that this prosodic patterning provides global structural information which subjects use in developing a representation of the utterance. To test this hypothesis Tyler & Warren ran a third experiment, using sentences in both Normal and Anomalous prose, in which the global syntactic structure was retained, while the global prosodic structure was disrupted. The results of this third experiment show that disruption of the global prosodic structure significantly slows down response times, in both the Normal prose and anomalous prose conditions. Tyler & Warren argue that these results show that it cannot be the case that prosodic information is used only when there are syntactic options, such as syntactically ambiguous phrases. Rather the findings suggest that prosodic information is an integral part of the comprehension process.

Concerning the consequences that the findings of these three experiments have for the question whether purely syntactic representations are computed, Tyler & Warren argue that:

> *"When listeners hear a normal utterance (...) the representation they construct is developed on the basis of local phrases which are integrated together by means of the semantic and prosodic relationships between phrases. As each word is heard, listeners use information about prosodic, syntactic, and semantic relationships between words to construct local phrases which have a coherent prosodic, syntactic and semantic structure. These local units are integrated into a higher level representation of the utterance on the basis of the semantic relationships between phrases, and the relationship between the prosodic structure within a phrase and the overall prosodic structure of the utterance. There is no evidence in the data presented here that a syntactic level of representation which spans an entire utterance is ever constructed."* (op. cit., p. 656).

In spite of these findings, proponents of the 'garden path model' maintain that the parser autonomously yields a syntactic representation in comprehension. In the next chapter, we will look in more detail at the evidence that they put forward in support of this claim.

The view that the parser operates according to special principles in addition to the rules of the grammar is not the only view held in the psycholinguistic literature. For example, Berwick & Weinberg (1984) argue that one can retain the view that only the rules of transformational grammar are used in language comprehension, if one assumes that the parser performs certain operations in parallel, rather than serially. They propose a two-stage parser which incorporates the use of the subjacency constraint, proposed in GB as a constraint on constituent movement. Fodor (1985) argues against this proposal on the grounds that it presupposes that the particular version of generative grammar in which the subjacency constraint plays a role is the grammar that underlies language use.

Garnham (1985) puts forward a more general argument against the equation of rules of grammar with rules used in processing:

> *"There are plausible arguments against the view that the rules people use in language processing are those discovered by linguists. Despite Chomsky's characterization of their discipline as part of cognitive psychology, linguists take no account of strictly psychological considerations. Their goal is to produce elegantly formulated grammars. But a concisely stated set of linguistic rules may not correspond to mental mechanisms, which are subject to processing constraints. A linguist's rules might require very complex computational procedures if they were to be incorporated into a language processor, whereas a slightly less elegant set of rules that had the same consequences for linguistic structure, might be computationally more tractable."* (Garnham, 1985, pp. 24-25).

However, Crain & Fodor (1985) assume as a working hypothesis that the grammar and the parser are well matched, i.e. that the rules of the grammar should be usable in a straightforward way in sentence processing. They argue that if the language processor cannot make use of the rules of grammar, but has to rely on heuristics to analyze sentences, processing would be a complicated matter which constantly threatens to exceed the capacities of the system. Crain & Fodor propose that by adopting their hypothesis,

> *"we may be able to appeal to the way in which [the parser and the grammar] interrelate in order to help us decide between various alternative grammars."* (Crain & Fodor, 1985, p.95).

They go on to compare what consequences transformational grammar (as set out in Chomsky, 1980b) and generalized phrase structure grammar, GPSG (e.g. Gazdar, 1981), would have for parsing sentences

containing fillers and gaps. They argue that the uniformity of the syntactic component of a GPSG, in which phrase structure rules and constraints are blended in the grammar, makes for efficient processing of sentences containing fillers and gaps, and go on to look at experimental evidence to see whether this claim is borne out. They find that although the experimental evidence is compatible with their claim, it does not provide positive evidence for it. However, they argue that:

> *"Other theories of grammar may be compatible with the on-line application of constraints by the parser, but only GPSG predicts it. The GPSG parsing model therefore recommends itself as a basis for current psycholinguistic research."* (Crain & Fodor, 1985, p.126).

However, this way of looking at the grammar-language processor relation raises a problem. Although a good case can be made for the view that, in an explanatory theory of comprehension, the rules of the grammar and the parser should be well matched, it is questionable whether this hypothesis justifies the move to use evidence from processing for deciding between the various alternative grammars, as proposed by linguists. Linguists working within the framework of generative grammar set out to investigate natural language by constructing fully explicit descriptions of the linguistic knowledge of language which underlies linguistic abilities. On this view, linguistics is mentalist, i.e. the reason for studying language in this way is to achieve an understanding of how the human mind uses language, and therefore linguistics is conceived of as a branch of cognitive psychology. However, this does not mean that the construction of linguistic theories is dependent on psychological evidence, or delimited by psychological considerations. As Black & Chiat (1981) argue:

> *"The notion of psychological reality has never played any role in the motivation of linguistic concepts or in linguistic argumentation. Its alleged role is simply due to a misleading use of the term 'psychological reality' to mean 'linguistic validity'."* (Black & Chiat, 1981, p.42).

Gazdar, Klein, Pullum and Sag (1985), in the introduction to 'Generalized phrase structure grammar', distance themselves from any psychological claims:

> *"We make no claims, naturally enough, that our grammatical theory is eo ipso a psychological theory. Our grammar of English is not a theory of how speakers think up things to say and put them into words. Our general linguistic*

> *theory is not a theory of how a child abstracts from the surrounding hubbub of linguistic and nonlinguistic noises enough evidence to gain a mental grasp of the structure of a natural language. Nor is it a biological theory of the structure of an as-yet-unidentified mental organ. It is irresponsible to claim otherwise for theories of this general sort."* (Gazdar et al., 1985, p.5).

However, to claim that psycholinguistic considerations can help to decide between various alternative grammars, presupposes that one of those grammars IS 'psychologically real', and that what we need to do is find the right one, be it GB, LFG, GPSG, or any other grammar. This has as an undesirable consequence that psycholinguistic explanations of comprehension are dependent on the particular grammar that has been adopted as the 'right' one, and that these explanations will have to change when changes in the grammar are made.

Nevertheless, psycholinguists continue to argue for or against different grammars on the grounds of psycholinguistic evidence. For example, Frazier, Clifton & Randall (1983) conducted some experiments in which they compared the processing of filler-gap sentences containing 'control' verbs and 'non control' verbs, such as in (1.4) and (1.5):

1.4. Non-control
  a. Who could the girl have begged ____ to sing?
  b. Who could the girl have begged to sing to ____?

1.5. Control
  a. Who could the girl have forced ____ to sing?
  b. Who could the girl have tried to sing to ___?

They found that sentences like (1.4a) take longer to comprehend than sentences like (1.4b). They propose that this is due to the fact that *the girl* is initially assigned to the gap in (1.4a), so that reanalysis has to take place later. They also found that sentences like (1.5a) take longer to understand than sentences like (1.5b). However, verbs like *force* are 'object control' verbs (i.e. these verbs required that their object be the subject of the infinitive), and verbs like *try* are 'subject control' verbs (i.e. verbs that require that their subjects be the subject of the infinitive), so that for the sentences in (1.5) only one interpretation is possible after the verb is encountered. This would lead one to expect that sentences like (1.5a) would not take longer to process than sentences like (1.5b). Because of these findings, Frazier et al. conclude that control information is not used during the first analysis of the sentence.

They go on to argue that their results fit naturally with a GB style grammar, because of the GB claim that there are distinct, finegrained components in linguistic knowledge. This claim permits the proposal that corresponding components are used in language input processing, and moreover that these components, such as control information, come into play at different points in time during the comprehension process. On the other hand, Frazier et al. claim that their findings are not compatible with the view that the grammar is a GPSG, because in such a grammar all relevant grammatical constraints are checked as the phrase structure representation of a sentence is constructed, so that one would expect that control information would have an immediate effect.

However, Ford & Dalrymple (1988) retort to this that Frazier et al.'s argument is flawed, and set out to show that the findings fit as naturally within a GPSG view, as within a GB view of the grammar. They argue that the findings of Frazier et al. can be accounted for within a GPSG, if we assume that the parser looks for the subject control form of verbs before looking for non-subject control forms.

Altmann & Steedman (1988) take a similar stance as Crain & Fodor (1985) concerning the relation between grammar and language processor, although they draw a different conclusion from this. They take as their starting point the 'strong competence hypothesis' of Bresnan and Kaplan (Bresnan, 1982), which proposes that rules of natural language grammar may be expected to correspond directly to the steps that a processor goes through in assembling a given analysis. Altmann & Steedman note that under this hypothesis the processor needs only two additional components: a mechanism for building interpretable structures according to the rules of the grammar, and a mechanism for coping with local ambiguities as to which rule of the grammar to apply.

However, they point out that if one takes this hypothesis together with the intuition that comprehension is an incremental process, this leads to a paradox. On this view, one would expect the grammar to be left-branching, because a terminal node in a left branching tree would be interpretable as soon as it is syntactically incorporated into a phrase, in a left-to-right pass through the sentence. English, however, is a striking example of a right branching language, which means that comprehension cannot occur in an incremental way, if the 'strong competence hypothesis' holds. There are different ways in which one can resolve this paradox. One way of doing this is to

reject the 'strong competence hypothesis', by pointing out that there is no necessary relation between rules of the grammar and the way in which language is interpreted. Altmann & Steedman reject this view, on the grounds that:

> *"...in the case of human language there is a price to pay in theoretical terms, for to abandon the strong competence hypothesis is to complicate greatly the problem of "plastic" or incremental development. The explanatory burden is merely shifted onto the theory of acquisition, and hence (by arguments familiar from Chomsky, 1968) onto the theory of evolution. In the absence of any good argument showing why the apparently extremely rapid evolution of language should have eschewed the obvious advantages of plasticity, such a move falls by Occam's razor."* (Altmann & Steedman, 1988, pp. 194-195).

They suggest that, rather than rejecting the 'strong competence hypothesis', or intuitions concerning the incremental nature of comprehension, the paradox can be resolved by rejecting standard theories of grammar. Instead one should opt for a grammar which is directly compatible with incremental semantics. As an example of this, Altmann & Steedman refer to 'combinatory grammar' (e.g. Ades & Steedman, 1982).

Altmann & Steedman go on to sketch a language processor which is 'parallel weak interactive', i.e. alternative syntactic analyses of ambiguous strings are offered in parallel, and a choice is made amongst them depending on the context. In order to account for how this choice is made, Altmann & Steedman propose two principles (cf. Crain & Steedman, 1985): the principle of referential support, which states that: *"An NP analysis which is referentially supported will be favoured over one that is not."*, and the principle of parsimony, which states that: *"a reading which carries fewer unsupported presuppositions will be favoured over one that carries more."* (Altmann & Steedman, 1988, pp.201-203). By introducing these two principles into their account of input processing, Altmann & Steedman move from the grammar-processor relation to processes which have access to the context, i.e. pragmatics, and their role in input processing. Although the principles make intuitive sense, a problem is that they do not follow from a general theory of pragmatics. Because of this, one cannot evaluate how they interact with other pragmatic processes, nor are they made completely explicit. For example, the notion 'presupposition' is problematic, in that there is no agreement as to what presuppositions are and how they are recovered from the input, nor as to whether presuppositions can be validly distinguished from

entailments (cf. e.g. Garner, 1971; Keenan, 1971; Kempson, 1975; Wilson, 1975).

The view that rules of the grammar should be directly usable in language processing is taken a step further in the view that the grammar is shaped by functional (processing) considerations. For example, Clark & Haviland (1974) argue that the study of language use will lead to an account of language itself, which in effect would make linguistics as a discipline redundant. Garnham (1985) argues against this view on the grounds that psycholinguists have produced very few linguistic insights, and besides that even if structural factors cannot explain all of language use, this does not mean that structural factors are unnecessary in the explanation.

Givon (1979) stresses the communicative purpose of language. He argues that formulating grammatical rules and constraints only describes phenomena of language, without providing an explanation for these phenomena. An explanation will only be possible when we take into account that the structure of language is based on its communicative function and on discourse-pragmatics. Newmeyer (1983) takes issue with this position by arguing that generative grammar is an explanatory theory. He says that the competence model as proposed by generative grammar interacts with other models to explain language. As an example, he refers to the unacceptability of multiple centre-embedded constructions, such as:

1.6. The cheese that the rat that the cat chased ate was rotten.

He argues that in order to explain the unacceptability of sentences like (1.6), we need both the competence grammar and a model of immediate memory storage. Having the competence grammar alone does not explain why sentences like the above are so difficult to process, because the grammar characterizes these sentences as grammatical. However, a memory model on its own can not account for this either, since *"even a rough description of the phenomenon demands a notion of linguistic structure"* (Newmeyer, 1983, p.124). A combination of the two models, Newmeyer argues, does give us an explanation of the sentence's unacceptability. Unfortunately, this combination of the two models still does not give us an explanation of why the sentence in (1.6) is unacceptable, while the sentence in (1.7), which has the same multiple centre-embedded structure, is fine:

1.7. The game those boys I met invented resembles chess.[1]

This means that it is not due to the syntactic structure of multiple centre-embedded sentences, nor to limitations of immediate memory storage, that some of these sentences are difficult or impossible to process. This in turn suggests that we may have to turn to pragmatics for an explanation of the phenomenon.

The view that processing considerations may help shape particular rules of the grammar is not completely rejected by generative linguists. For example, Chomsky & Lasnik (1977) consider functional explanations of grammatical rules in the light of the fact that sentential subjects in English require a complementizer. However, Chomsky (1980) points out that even when there are functional explanations for linguistic rules, these functional explanations apply only on the evolutionary level, either the evolution of the organism, if the rule is a universal, or the evolution of the language, if the rule is language specific. In either case, Chomsky argues,

> *"the child does not acquire the rule by virtue of its function any more than he learns to have an eye because of the advantages of sight."* (Chomsky, 1980, p. 231).

Carston (1988) puts forward two main reasons why a complete functional explanation of grammatical rules and constraints does not seem possible. In the first place, she notes that there are innumerable local ambiguities in natural language that are not excluded by grammatical rules and constraints although their exclusion would facilitate parsing. And in the second place, that there are constraints which do not facilitate sentence processing, and may even make processing more difficult. However, until we have a better insight into how addressees actually process sentences, it is difficult to evaluate whether these two points are valid because they rest on unvalidated assumptions concerning language processing. For example, although it is the case that sentences of natural language contain numerous local ambiguities, it has not been shown convincingly that this presents the processor with difficulties when it interprets actual utterances of these sentences, so that it is not obvious that if these ambiguities were ruled out by the grammar this would facilitate processing.[2] Moreover, the reasons Carston gives against functional explanations of grammatical rules and constraints rest on the assumption that the rules and constraints proposed by linguistic theory are 'psychologically real'. For example, Carston says that the constraint that prohibits (1.8) seems to have no role in aiding perception because the sentence is completely straightforward to parse,

so that there cannot be a functional explanation for having the constraint:

1.8. *Who do you think that ___ will win?

The fact remains that people find (1.8) unacceptable. If the syntactic constraint which prohibits this structure is mentally represented as such, then the unacceptability of (1.8) may well be due to this constraint. However, an alternative explanation is that sentences like (1.8) do present some processing difficulties, which make people judge them to be unacceptable, even if they seem perfectly straightforward to parse to linguists.[3] If this is the case, then identifying what causes the processing difficulties would give us a functional explanation of why sentences like (1.8) are ruled out.

It seems that in order to decide on whether rules of the grammar are shaped by functional considerations, we need better answers to the question of how people process language. To do this we need to be clearer about the motivation for many of the assumptions on which psycholinguistic theories have been based. Some of these assumptions have been adopted not because they were supported independently by psycholinguistic evidence, but because they followed from, or were more compatible with, more general cognitive hypotheses or linguistic metatheory. As we have seen in this section, the linguistic metatheoretical notion of 'psychological reality' of the grammar underlies much psycholinguistic theorization and research. Fodor (1983) has incorporated this view of the grammar into a general theory of the organization of the mind, the modularity hypothesis. This has been interpreted by many psycholinguists as independent motivation for the assumption that processing proceeds by means of the stages and types of representations postulated in linguistic theory. In the next section, we will look at Fodor's proposals in more detail, and ask whether the modularity hypothesis does indeed provide independent motivation for a particular architecture of psycholinguistic models.

1.2. Is the language faculty a Fodorian module ?

Fodor (1983) presents an account of the overall organization of the mind, in which he distinguishes three types of cognitive mechanisms, transducers, input systems and central mechanisms. Input systems mediate between transducer outputs and the central cognitive mechanisms by computing representations usable by the central mechanisms, based on "transduced premises". Fodor proposes that these input systems

consist of the perceptual systems and language. He includes language on the basis of the similarity of function between the linguistic and the perceptual systems:

> *"both serve to get information about the world into a format appropriate for access by such central processes as mediate the fixation of belief."* (Fodor, 1983, p.46).

Furthermore, Fodor claims that, although both input systems and central systems are inference-making systems, they differ in that input systems are modules, whereas central systems are not, i.e. input systems share a number of properties which make them modular, and which are not shared by the central cognitive systems. Some of the properties that make a system modular are that the system is domain specific; that processing is mandatory; that there is only limited central access to the representations that the system computes; that the system is fast; that the system is informationally encapsulated; and that the system computes a 'shallow' output. Fodor argues that language processing shares these properties, i.e. it is fast, dumb and automatic. We cannot help hearing an utterance of a sentence in a language we know as a sentence of that language rather than as a string of sounds.

Fodor assumes that the interpretation of an utterance involves making an analysis of the input at a number of different levels of representation, such as phonetic, phonological, lexical, and syntactic. At each of these levels, the analysis involves idiosyncratic computations, which make the different operations domain-specific. Moreover, in performing its analyses the language processor can only make use of information within the module. Information derived from central processes cannot directly affect the analysis of the language processor. In this way, input systems are 'informationally encapsulated', which Fodor calls *"the essence of their modularity"* (op. cit., p.71). Informational encapsulation is one of the reasons why input systems, including language processing, operate very fast: they operate by only taking a limited amount of information into consideration. Because input systems are informationally encapsulated, their outputs will be 'shallow', i.e. the output will be a representation of the input which can be computed without any appeal to general knowledge. Fodor (1983) puts forward that in the case of language, the processor specifies its linguistic and maybe its logical form. Fodor (1990) goes one step further and proposes that there is an algorithm which is used by the language processor to take an

addressee from the acoustic properties of an utterance P to a canonical description of the communicator's mental state, i.e. a description of the communicator as intending to communicate his belief that P. Fodor says about this that:

> *"All you have to know about an English speaker is that he made a certain noise, and the intentional interpretation of his behaviour is immediately transparent. (...) There appears to be something like a procedure for the intentional interpretation of verbal behaviour; but all that executing the procedure gives you is a specification of the propositional object of a communicative intention. The only intentional information about a speaker that his colinguals are ipso facto able to recover from his verbal behaviour is the literal content of what he says. For all the other sorts of things that you might want to know about the speaker's state of mind ("Why did he say that?" "Did he mean it?" ...) you're on your own; hermeneutic sophistication comes into play, mediated by heaven knows what problem solving heuristics."* (Fodor, 1990, p.214).

However, Wilson & Sperber (1981), and Sperber & Wilson (1986) have shown that processes such as reference assignment, disambiguation, and the restoration of elliptical material crucially involve pragmatics and context, which are not part of the language faculty. They also show that recovering the content of what someone has said often involves more than the above processes: the linguistic input has to be enriched in various ways in order to yield a complete proposition (for a more detailed discussion of this, see section 1.4). This process of enrichment again is not part of the language faculty, but involves central cognitive processes and context (see also Blakemore, 1987; Carston, 1988). This means that for Fodor's proposal to have any substance, he will have to show what algorithm, within the informationally encapsulated language input system, can account for reference assignment, disambiguation, the restoration of elliptical material, and enrichment. Furthermore, he will have to account for the experimental finding that people do not need to first process the literal meanings of non-literal expressions before deriving their non-literal interpretations (e.g. Gibbs, 1986, 1989).

Marslen-Wilson & Tyler (1987) take issue with Fodor's (1983) view of modularity on two grounds. They argue that the properties proposed to distinguish modular from non-modular systems are not in fact distinguishing properties; and they argue that the proposed properties lead Fodor to make unwarranted assumptions about the language processor.

Fodor proposes that modules have specific domains in which they perform idiosyncratic computations, which indicates a specialized processor. However, Marslen-Wilson & Tyler point out that Fodor does not provide any arguments or evidence that the mapping of linguistic representations onto discourse representations is any less domain specific. It may well be that this process is as domain-specific and idiosyncratic as the mapping from the acoustic input onto 'shallow' linguistic representations.

Sperber & Wilson (1986) propose that the linguistic content of an utterance underdetermines its propositional content, i.e. a semantically complete logical form. The output of the linguistic decoding process is taken to be an incomplete (non-linguistic) logical form, which the addressee then has to complete into the fully propositional form, which the communicator intended to convey. This process of enriching the incomplete logical form is a pragmatic process, which makes use of general conceptual knowledge, and is therefore outside the realm of the 'language faculty'. Although this process of enrichment is not part of the language input system, it solely applies to incomplete logical forms, turning them into propositional forms, which makes it 'domain specific'.[4] Fodor concedes that domain specificity is not a strong argument for modularity: although it seems a good characteristic of modular systems that they operate in specific domains, the reverse, that 'domain specific' operations are modular, does not automatically follow.

Concerning Fodor's claim that modular processes are mandatory (i.e. that they apply automatically, whereas central processes do not), Marslen-Wilson & Tyler remark that there is no reason to suppose that mandatory processing stops at logical form, which Fodor claims is the output of the language input system. As an example they give (1.9), uttered in a normal conversation after a lecture:

1.9. Jerry gave the first talk today. He was his usual ebullient self.

They say about this example that:

> *"Hearing this, it seems just as cognitively mandatory to map the pronoun <u>He</u> at the beginning of the second sentence onto the discourse representation of <u>Jerry</u> set up in the course of the first sentence as it does, for example, to hear <u>All Gaul is divided into three parts</u> as a sentence and not as an acoustic object (...)."* (Marslen-Wilson & Tyler, 1987, p.39).

Fodor does not give any arguments for why processing would be mandatory only up to logical form. He notes that:

> *"Perceptual processes apparently apply willy-nilly in disregard of one's immediate concerns. "I couldn't help hearing what you said" is one of those cliches which, often enough, expresses a literal truth; and it is what is* said *that one can't help hearing, not just what is* uttered." (Fodor, 1983, p. 55).

However, as is implicit in Marslen-Wilson & Tyler's criticism, the question is what Fodor means by 'what is said'. As we saw above, Wilson & Sperber (1981) and Sperber & Wilson (1986) have shown that recovering 'what is said' crucially involves pragmatic processing and context, which are not part of the language faculty, so that the above quote argues against the view that processing is mandatory only up to logical form, rather than for it. Fodor's (1990) proposal reflects the position that mandatory processing continues until the content of the utterance is recovered. However, as we saw above, unless it can be shown that there is an algorithm within the language input system which can compute the content of an utterance without appeal to general knowledge, this proposal entails that not only processing up to logical form, but also the central processes involved in utterance interpretation are mandatory.

Fodor says that 'informational encapsulation' is at the core of modularity. He argues that if it is not the case that at least some information is encapsulated, then we would not be able to account for the persistence of many perceptual illusions, even when the subject has explicit knowledge that the percept is an illusion, such as the Muller-Lyer illusion in vision. For language processing, Fodor gives as an example of informational encapsulation the finding by Swinney (1979), and Tanenhaus, Leirnau & Seidenberg (1979), that on hearing an ambiguous word both readings are accessed. Swinney (1979, 1982) set out to test the intuition that biasing contexts facilitate lexical decisions. He presented subjects with sentences like *I wanted to write a letter to my mother but I couldn't find a pen.* After processing the sentence subjects did a lexical decision task, i.e. they were presented with a word about which they had to decide whether it was a word or a non-word. Swinney found that decision times were faster for words related to the target word (i.e. pen), such as *ink*, than for words which were unrelated to the target word, such as *king*. However, *pen* is ambiguous between a reading 'writing material' and a reading 'animal enclosure', and Swinney found that words related to the

reading which was not facilitated by the sentential context, such as *pig*, were also recognized faster than the unrelated word. Swinney found that both readings of *pen* are accessed in all contexts, whether the context is neutral, or biased towards one or the other reading. Fodor argues that because the access of both readings is facilitated, even though only one reading is contextually relevant, these experiments show that lexical access is not cognitively penetrated, but rather informationally encapsulated: *"This looks a lot less like the intelligent use of contextual/background information to guide lexical access."* (op. cit., p.79). To account for this, Fodor argues that:

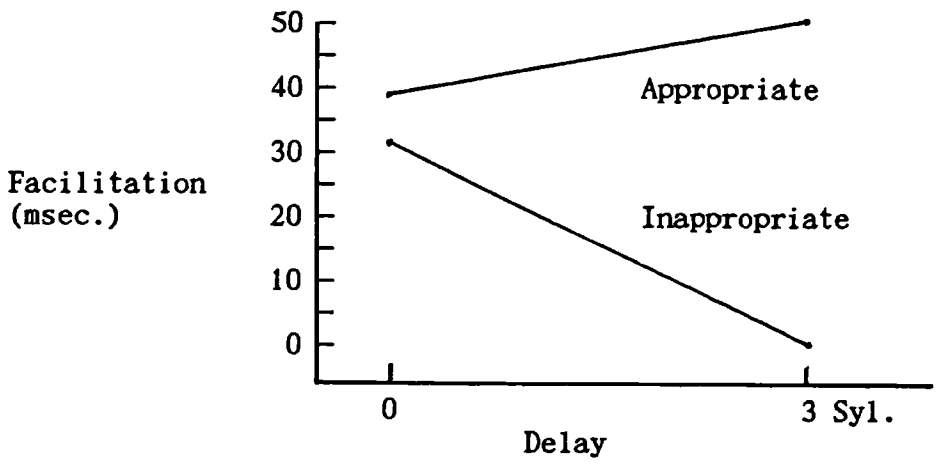
> *"what it looks like (...) is some sort of associative relation among lexical forms (...); a relation pitched at a level of representation sufficiently superficial to be insensitive to the semantic content of the items involved. This possibility is important for the following reason: if facilitation is mediated by merely interlexical relations (and not by the interaction of background information with the semantic content of the item and its context), then the information that is exploited to produce the facilitation can be represented in the lexicon; hence internal to the language recognition module. And if that is right, then contextual facilitation of lexical access is* not *an argument for the cognitive penetration of the module.* (op. cit., p.79–80).

There are two points that can be made regarding this account. Fodor presents the mental lexicon as "*a sort of connected graph, with lexical items at the nodes and with paths from each item to several others.*" (op. cit., p.80). This raises the question of what he means by 'lexical item'. In the psycholinguistic literature, a distinction is usually made between stored word forms (phonological and orthographic), and stored word meanings (cf. Aitchison, 1987; Garman, 1990; Garnham, 1985). Since Fodor discusses a level of representation which is "*insensitive to the semantic content of the items involved*", it seems that what he means by 'lexical items' are stored word forms, rather than word meanings. However, although it has been proposed in the literature that word meanings may be stored in semantic networks, no such semantically inspired networks have been proposed for word forms. Rather, the psycholinguistic evidence shows that word forms are organized around similarities in sound, especially around similarity at their beginnings and ends (e.g. Aitchison, 1987; Fay & Cutler, 1977). If this is correct, then Swinney's findings must be due to the semantic content of the words involved.

More importantly, the conclusions drawn from the experiments by Swinney and others turn out to be unwarranted. Underlying these conclusions is the assumption that lexical access is a one-step process: either a word meaning is accessed or it is not. Based on this assumption, the finding that both readings of an ambiguous word are accessed is taken as evidence that context cannot facilitate one reading of an ambiguous word at early stages of recognition or access. However, an alternative view of lexical access is that it involves a continuous gradual activation process, rather than a single step. Based on this we can view lexical access as a joint function of contextual and phonological input: both phonological input and context contribute to the activation of a word meaning. On this view, although the phonological form of an ambiguous word will activate all readings of an ambiguous word, the contextually appropriate reading will also receive activation from the context, so that this reading will be activated more. As the activation process continues, the contextually appropriate reading will come to dominate, while the inappropriate reading(s) will be pushed out (as proposed by Kawamoto, 1988; McClelland, St. John & Taraban, 1989).

This second view of lexical access is supported by research of St. John (1988), reported in McClelland et al. (1989). St. John reanalyzed the findings of 19 studies concerning lexical access of ambiguous words (including Swinney's experiments). This reanalysis reveals that even at the earliest probe point, although both readings of the ambiguous word are activated, the contextually appropriate one is activated more. As processing continues, facilitation of the appropriate reading continues, while facilitation of the inappropriate reading fades away. This pattern is illustrated in figure (1), which shows St. John's reanalysis of Swinney's (1979) experiment:

fig. 1. Swinney, 1979 (Expt. 2)



What we see then is that the findings concerning lexical access of ambiguous words do not support Fodor's claims of informational encapsulation, but rather show that context does play a role in lexical access.

In the case of structural ambiguity, Fodor allows for limited interaction between the language processor and central systems. Although the central systems cannot guide the analysis that the processor makes, it can reject an analysis on the grounds of contextual incompatibility.

Marslen-Wilson & Tyler claim that Fodor has no evidence that the relationship between syntactic parsing and central processes is interactive in the way he proposes. They go on to discuss a number of findings of experiments, including those of Marslen-Wilson & Tyler (1980) discussed above, which they interpret as evidence for the hypothesis that context does guide the parser on-line. They point out that:

> *"The results do not force a single-computation account. No matter how early context effects are detected, it is always possible to argue that multiple readings were nonetheless computed, so that what we are picking up are after-the-event-selection effects rather than direct control of the initial syntactic parse. But the cost of this move is that it makes it very difficult to discriminate the modular version of interaction from an account that allows continuous or even predictive interactions between levels. The modular account simply fails to make empirically distinct predictions. And if this is the case, then the claim for informational encapsulation cannot help us to distinguish modular from central processes."* (op. cit., p. 51).

Fodor argues that the point at issue is that context cannot predict the linguistic form of an utterance, however much it may predict its content. He says that even if one knows what a communicator is going to say, one cannot know in what way s/he is going to say it; *"there are simply too many linguistically different ways of saying the same thing."* Because of this, he argues that *"linguistic form recognition can't be context driven because context does not determine form, if linguistic form is recognized at all, it must be by largely encapsulated processes."* (Fodor, 1983, p. 90).

There are a number of points that can be made regarding this argument. Although Fodor says that 'informational encapsulation' is at the core of modularity, it turns out that whether (post-lexical) processing is 'informationally encapsulated' and therefore modular, depends on whether linguistic form is recognized prior to, and

independent of the conceptual (or discourse) representation of an utterance. Fodor refers to experimental evidence by Forster & Olbrei (1973) to support his claim that linguistic form recovery is mandatory. Forster & Olbrei conducted a number of experiments which they argued showed that syntactic processing time is constant for sentences of varying semantic plausibility but constant syntactic structure. In one experiment they compared reaction times to semantically plausible and implausible sentences containing one or two clauses. The different sentences used had the same syntactic structure, and all sentences contained seven words. Moreover, the average word length was equated for all four sentence types. Examples of sentences used are given in (1.10):

1.10a. <u>One-clause plausible:</u>
The officials were given a warm reception.

b. <u>One-clause implausible:</u>
The aborigines were shown a rusty invention.

c. <u>Two-clause plausible:</u>
The dress that Pam wore looked ugly.

d. <u>Two-clause implausible:</u>
The aunt that Jim ate tasted foul.

Forster & Olbrei found that the semantically implausible sentences took longer to process than the semantically plausible sentences, and furthermore, that two-clause sentences of each type took longer to process than one-clause sentences of the same type. Forster & Olbrei took these results to show that the time required to analyze a particular syntactic structure is approximately constant, while differences between the plausible and implausible sentences are due to semantic processing.

However, when we look at the method that Forster & Olbrei used in conducting their experiments, it turns out that their conclusion is not warranted. They use the notions 'semantic plausibility' and 'semantic implausibility' in an intuitive sense, without giving any theoretical justification for what makes a sentence semantically plausible or implausible. This means that one cannot be sure what the experimental findings signify, since what is being compared is not spelled out. Also, in all experiments that Forster & Olbrei conducted, subjects read the sentences in their totality, and had to decide for each sentence whether it was an intelligible, grammatical

sentence. This means that the reaction times reflect the overall time it took the subjects to interpret the sentences, so that one cannot tell from the reaction times how much time was spent on the different subprocesses, such as syntactic processing, or indeed whether any purely syntactic processing had taken place at all. These experiments, therefore, do not show whether linguistic form recovery is mandatory. Moreover, this experimental evidence can be contrasted with Tyler & Warren's (1987) finding discussed above that, when the global constituent structure of a sentence is scrambled, this does not significantly slow down reaction times, relative to those obtained on syntactically well-formed sentences.

Although context may not be able to predict the exact linguistic form that an utterance is going to have, it does not follow automatically from this that it cannot be used to make any predictions at all. Let us consider the following example:

1.11. Ann: Where did you put the book?
  a. Pat: I put it on the table.
  b. Pat: On the table.

If the context predicts that the content of Pat's utterance is going to be a specification of SOMEWHERE in the conceptual representation PAT PUT BOOK SOMEWHERE, then although it cannot predict whether Pat is going to utter (1.11a) or (1.11b), it may predict that the utterance is going to be constrained by this conceptual representation. Of course there is no guarantee that the prediction is not mistaken, i.e. that Pat will not say something completely different, such as "*Oh, shut up*". However, if the context predicts that Pat will specify where she put the book, then this utterance will startle Ann, because she was not expecting it. Moreover, if Pat said "*I can't remember*", in the above example, Ann needs the conceptual representation to reach the interpretation that Pat cannot remember where she put the book. The point is that although there may be "*many linguistically different ways of saying the same thing*", underlying the different linguistic realizations will be one conceptual representation, otherwise it would not be '*the same thing*'. This means that if one knows what a communicator is going to say, one has a conceptual representation of the utterance; and this conceptual representation constrains the linguistic form of the utterance that one expects the communicator to utter.

A further property which Fodor proposes as distinguishing modular systems from central systems is that modular systems are fast, whereas central processes such as problem solving are relatively slow. However, Sperber & Wilson (1986) point out that pragmatic processing is constrained as to how much time is spent:

> *"... ordinary utterance comprehension is almost instantaneous, and however much evidence might have been taken into account, however many hypotheses might have been considered, in practice the only evidence and hypotheses considered are those that are immediately accessible."* (Sperber & Wilson, 1986, p.66).

Similarly, Marslen-Wilson & Tyler (1987) argue that this property cannot help one distinguish a language input system from central processes involved in interpretation, because the available evidence shows that mapping onto a discourse representation happens as fast as any (postulated) mapping onto a logical form, even when it involves pragmatic inference.

In point of fact, Fodor has very little to say about the central processes involved in on-line language comprehension. His main concern is to compare processes of input systems with central processes such as problem solving and belief fixation. When he talks about central processes involved in language comprehension, he refers primarily to such processes as recovering the illocutionary force of the utterance, and not to such processes as disambiguation and reference assignment. However, it is not at all inconceivable that there are differences between these different types of central processes.

There are two further distinguishing properties that Marslen-Wilson & Tyler claim do not make a distinction between modular and central processes. Fodor claims that intermediate modular levels of representation are less accessible to central processes than the output representation. Moreover, Fodor claims that this output of the language input system is a 'shallow' output, i.e. linguistic or logical form. Marslen-Wilson & Tyler argue that in a series of processes the output of one process will automatically be overwritten by another, without this giving any special status to the last representation other than it being the last. And furthermore, this begs the question of which level of representation is the output representation. Whether the output of the language input system is a 'shallow output' needs to be researched, and cannot simply be assumed.

Marslen-Wilson & Tyler argue that, on their analysis of the properties proposed by Fodor, the output of the class of mandatory, fast processes does not distinguish modular from central processes, nor linguistic from nonlinguistic processing. Marslen-Wilson & Tyler also argue that the 'hidden agenda' of the modularity thesis is to equate the constructs of linguistic theory with psychological processes of language comprehension. This invites one to accept assumptions about the language processor, rather than to question these assumptions.

In order to answer these criticisms put forward by Marslen-Wilson & Tyler, it seems then that the onus falls on proponents of the modularity thesis to show (among other things) that addressees compute syntactic representations. Tanenhaus et al. (1985) discuss the question of whether the hypothesis that listeners compute linguistic representations can be preserved as a hypothesis with empirical content. They point out that this hypothesis faces the problem that, when processing utterances, one cannot identify a temporal stage at which a mental representation of a complete sentence is a linguistic representation. They suggest that one possibility, "*maybe the only viable one*", is to adopt the modularity thesis. They take as a working hypothesis that a (linguistic) logical form representation is computed, as well as a 'constructed representation', a non-linguistic conceptual level of representation. They present some experiments based on work by Hankamer & Sag (1976), and Sag & Hankamer (1984). Sag & Hankamer propose that there is a distinction between deep and surface anaphors, which is due to the different anaphors finding their referents at different levels of representation. Surface anaphors do not allow for pragmatic control and find their referent in a preceding logical form, whereas deep anaphors do allow pragmatic control and find their referent in the addressee's discourse representation (in the constructed representation). On this account VP-ellipsis is an example of a surface anaphor, whereas definite pronouns are deep anaphors, as in Sag & Hankamer's (1984) example:

1.12. (Hankamer fires a gun at stage right. A blood-curdling female scream is heard.)

a. Sag: *I wonder who was. (no pragmatic control, surface anaphor)

b. Sag: I wonder who *she* was? (pragmatic control possible, deep anaphor).

Sag and Hankamer note that another difference between deep and surface anaphors is that there can be a lot of intervening material

between a deep anaphor and its referent, but not between surface anaphors and their referents, as in (1.13) and (1.14):

1.13. Someone has to paint the garage.
   a. Let's take a vote and see who has to do it. (deep anaphor)
   b. Let's take a vote and see who. (surface anaphor)

1.14. Someone has to paint the garage. The paint is peeling and the wood is beginning to rot.
   a. Let's take a vote and see who has to do it. (deep anaphor)
   b. ?? Let's take a vote and see who. (surface anaphor)

Again, this difference can be explained if one proposes that surface and deep anaphors get there referents from different representations. Hankamer & Sag assume that memory for logical form decays quickly, which can explain why the surface anaphor in (1.14) is awkward, while the deep anaphor is fine.

Tanenhaus et al. (1985) tested whether deep and surface anaphors, as in (1.13) and (1.14), are processed differently. They found that in the condition without any intervening material (as in (1.13)), surface anaphors were processed more quickly than deep anaphors. However, in the condition with intervening material (as in (1.14)), deep anaphors were processed more quickly than surface anaphors. The question is whether findings from experiments like this constitute evidence for different levels of representation. Although the findings can be explained by proposing that the anaphors get their referents from different levels of representation, this is not the only explanation possible. Let us look again at the example in (1.12):

1.12. (Hankamer fires a gun at stage right. A blood-curdling female scream is heard.)
   a. Sag: *I wonder who was (no pragmatic control, surface anaphor)
   b. Sag: I wonder who *she* was? (pragmatic control possible, deep anaphor).

In the situation in (1.12), one can conclude, through observation and inference, that there was someone present apart from Hankamer and Sag, that that person was female, that she screamed, that therefore she could have been in the firing line, and that she maybe was shot, or that she was frightened by the shot. In order to interpret Sag's utterance in (1.12a), one has to establish which of the properties, sketched above, Sag is referring to, *shot*, *frightened*, *screaming*, or even *in the firing line*, or *present*. Because Sag could in principle

have intended to convey any of these, the addressee has nothing to go on to decide for one particular interpretation. In contrast, the interpretation of Sag's utterance in (1.12b) is constrained by his use of the pronoun *she*, which directs the attention of the addressee to the identity of the female person already present in the non-linguistic context. The problem with (1.12a) then is that Sag does not constrain his utterance enough to guide the addressee to the intended interpretation, so that the utterance seems awkward. In other words, the difference between (1.12a) and (1.12b) can be explained, not by reference to different levels of representation, but rather by proposing that both get their interpretation from the "constructed representation".

When we look at example (1.14), we see that the situation is reversed, with respect to the "deep" and "surface" anaphors:

1.14. Someone has to paint the garage. The paint is peeling and the wood is beginning to rot.

a. Let's take a vote and see who has to do it. (deep anaphor)

b. ?? Let's take a vote and see who. (surface anaphor)

In order to interpret (1.14a) and (1.14b), the addressee has to establish which predicate the communicator intended to convey. In the preceding utterances three predicates are given, *is beginning to rot*, *is peeling*, and *has to paint the garage*. The utterance in (1.14a) guides the addressee to the right interpretation, because of the repetition of *has to*. Moreover, if one accepts the proposal of Tanenhaus et al. (1985) that *it* in *do it* refers to an activity, then only the activity of painting the garage will yield an interpretation. The utterance in (1.14b), on the other hand, is not constrained as to which predicate the communicator intended to convey. This means that the addressee will have to access and evaluate all three predicates, and that by uttering (1.14b), the communicator encourages the addressee to consider *who is beginning to rot*, and *who is peeling*, which makes the utterance in (1.14b) awkward. In other words, the difference between (1.14a) and (1.14b) can be explained, not by referring to different levels of representation, but rather by the momentary indeterminacy of the interpretation of (1.14b) as opposed to (1.14a).

Given that there are alternative explanations of why the different anaphors are more or less difficult to interpret in different contexts, experiments involving the distinction between surface and deep anaphors cannot constitute evidence for the claim that addressees compute

logical form as well as conceptual representations. Furthermore, if it is the case that the difference in ease of processing of the different anaphors is not due to different levels of representation being involved, but rather to the interaction of the anaphor used with the context, then the distinction between deep and surface anaphors becomes much less clear-cut than was sketched above.

As we saw above, adopting the modularity thesis was put forward by Tanenhaus et al. (1985) as a way of preserving the hypothesis that listeners compute linguistic representations as a hypothesis with empirical content. However, the modularity thesis does not commit one to the view that linguistic representations are computed. By allowing weak interaction between the syntactic processor and central processes, the modularity thesis can accommodate parallel weak interactive models of language input processing, such as Altmann & Steedman's (1988) proposal discussed above. But as we saw, this proposal entails that although the processor makes use of rules of the grammar, it does not compute linguistic representations.

Frazier (1987c) discusses a number of problems that she claims a non-modular discourse driven model faces. One problem that is specifically determined by the non-modularity of such a model, is inspired by a further property Fodor proposes input systems to have. This property is that input systems are associated with fixed neural architecture. Fodor argues that we find neurological structure associated with language and other input systems, but not with central systems or processes. Frazier argues that the apparent fact that humans are specialized for language may present a challenge for a non-modular discourse oriented model of language processing. If there is no clear cut off point between linguistic processes and pragmatic processes, then it becomes quite unclear what it is that humans are specialized for. Although the left, language dominant hemisphere cannot be specialized for all aspects of language processing, a modular approach suggests that what humans are specialized for is the grammatical aspects of language processing. Frazier argues that on a non-modular discourse driven approach it is quite unclear what else there could be, apart from phonetic processing.

Whether this argument is valid depends entirely on what kind of non-modular discourse oriented model is proposed. For example, Marslen-Wilson & Tyler propose a processing model in which no linguistic level is computed between lexical representations and a

representation of the message that the communicator intends to convey. Marslen-Wilson & Tyler assume that the rules of syntax describe the process which takes one to a semantic interpretation; there is no need to postulate that a syntactic representation is computed. However, they propose that language processing makes use of *"a stable set of highly skilled, automatized processes that apply obligatorily to their characteristic inputs."* (op. cit., p. 58). These processes apply bottom-up, at least as long as the input is unambiguous and complete. In cases of ambiguity and incompleteness, contextual factors come into play and may even guide the interpretation. On the assumptions that there is a stable set of processes which apply obligatorily, it may well be that these processes are "what humans are specialized for". Moreover, if the process of mapping onto discourse representations is as 'domain-specific' as any input system process proposed by the modularity thesis, then this may also turn out to be a process that humans are specialized for.

The remaining two properties that Fodor proposes as distinguishing modular systems from non-modular systems are that input systems exhibit characteristic and specific breakdown patterns, and that the ontogeny of input systems exhibits a characteristic pace and sequencing. However, Fodor concedes that these two properties do not necessarily define modular systems, although they are compatible with there being modular systems.

What we have seen then is that the properties that Fodor proposes for distinguishing input systems from central systems do not in fact distinguish purely linguistic processes from central processes involved in language comprehension. Although Fodor says that informational encapsulation is central to the modularity thesis, when we look at the process of lexical decision it turns out that this is in fact 'informationally penetrated'. In the case of post-lexical input processing, we saw that evidence that Fodor cites in support of purely linguistic processing and the recovery of a purely linguistic representation does not in fact constitute evidence for the claim that linguistic form recovery is mandatory. The findings of Tyler & Warren (1987), on the contrary, indicate that an overall linguistic representation is not recovered. It seems then that rather than the modularity thesis being an a priori limitation on the form a psycholinguistic model can take, it makes the wrong predictions concerning how people actually process a linguistic input.

1.3. Language processing and cognition.

Most objections that Marslen-Wilson & Tyler raise against the modularity thesis are based on assumptions about the role that pragmatic processes play in language comprehension. In order to further evaluate their objections, we should have a closer look at these processes. Unfortunately, pragmatic processes are the least well understood processes within psycholinguistics, and there is, as yet, little psycholinguistic theorisation of how an addressee computes a full interpretation of the linguistic input. This has not stopped psycholinguists from conducting experiments involving notions such as 'pragmatic (im)plausibility' and 'pragmatic anomaly' (e.g. Holmes et al., 1989; Rayner et al., 1983; Tanenhaus et al., 1985, 1989). However, these notions have no theoretical content, and are used only intuitively, so that we should be cautious about interpreting the findings.

Until recently there was only one serious theory of pragmatics, that developed by Grice (1975). He proposes that conversation is governed by the Co-operative Principle, which he formulates as:

> *"Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged."* (Grice, 1975, p.45).

Grice proposes a number of conversational maxims which spell out in more detail what is meant by the Co-operative Principle. Furthermore, Grice introduces a distinction between 'what is said' by an utterance, and 'what is implicated'. Working out 'what is said' involves recovering the linguistic meaning of words, disambiguation and reference assignment. Implicatures on the other hand have to be calculated. Work in Gricean pragmatics has been largely concerned with how implicatures are recovered, while little has been said about how reference assignment and disambiguation take place. However, reference assignment and disambiguation, as well as such processes as restoring elliptical material, are part of computing the full interpretation of an utterance, so that a theory of language comprehension should account for these processes. Because of its preoccupation with implicatures, the Gricean approach to pragmatics is not explicit enough to provide a basis for such an account. More promising are the pragmatic principles proposed by Altmann & Steedman (1988). However, as we saw above, these principles face a number of

problems, such as that they do not follow from any general theory of pragmatics.

Because processes such as reference assignment and disambiguation involve context and background knowledge, they cannot be explained as part of linguistic processing, but are situated within the domain of the central cognitive systems. This has as a consequence that the linguistic input has to be represented in a format that is usable by the central systems. This means that in order to get more insight in how an addressee achieves a full interpretation of an input, two questions need to be addressed, the question of what kind of representations are used by the central systems, and the question of how the central systems involved in language comprehension operate.

In the literature the outcome of the interpretation process is referred to by many different names, such as the 'discourse representation', and the 'constructed representation'. The question is what these representations consist of. One proposal (see, for instance, Chomsky (1986)), is that the language faculty is used in both speaking and thought, i.e. that the representations used in thinking are linguistic representations. Fodor (1975) argues against this view, and instead proposes that there is a separate 'language of thought'. The language of thought is language-like, in that thoughts are like sentences, they consist of strings of structured symbols. It is in virtue of their being structured that inferences can be drawn over these strings. However, thoughts are conceptual representations, rather than linguistic representations.

Fodor advances a number of arguments for the view that thoughts are like sentences. Amongst other things, he argues that thinking, like language, is productive and systematic. We can, in principle, utter an indefinite number of different sentences, and similarly, we can, in principle, think an indefinite number of different thoughts. Moreover, if we can utter a sentence like *John saw Mary*, then we can utter a sentence like *Mary saw John*; likewise if we can think *John saw Mary*, then we can think *Mary saw John*. That we can utter sentences like the above is due to our having a finite lexicon and rules as to how lexical items can be combined to form sentences. Because we can think thoughts such as the above, we must have rules for combining concepts to form these thoughts. Although language and thoughts are alike in these respects, Fodor argues against the view that the public language is used in thought on two grounds. He argues that there are nonverbal organisms that think. Prelinguistic children and (some)

animals show evidence of such actions as problem solving and remembering, which involve computation. Since computation needs a medium to operate in, they must have a non-linguistic system of representation. Fodor also argues that learning one's first language involves hypothesis formation and confirmation. It follows from this that we need to have a representational system which is at least as expressively powerful as the system that is being learnt, because otherwise we would not be able to formulate these hypotheses.

An alternative account of the language of thought hypothesis is proposed by, for example, Smith (1982), and Devitt & Sterelny (1987). They propose that one may start with a non-linguistic system of representations, which serve as the basis for language acquisition. As the natural language is learned, it is incorporated into the non-linguistic system and ultimately becomes the system of mental representations as well as the system of communication.

Sperber & Wilson (1986) argue against the view that the language of thought is natural language, on the grounds that the semantics of natural languages may be too weak to encode all humanly thinkable thoughts. In discussing Katz's 'principle of effability', which says that: *"Each proposition (thought) is expressible by some sentence in every natural language."* (Katz, 1981, p. 226), they argue that the way in which we represent things, need not be in terms of any external-language definite description. They say that:

> *"It seems plausible that in our internal language we often fix time and space references not in terms of universal co-ordinates, but in terms of a private logbook and an ego-centred map; furthermore, most kinds of reference - to people or events for instance - can be fixed in terms of these private time and space co-ordinates. Thoughts which contain such private references could not be <u>encoded</u> in natural languages, but could only be incompletely represented."* (Sperber & Wilson, 1986, p. 192).

However, it does not necessarily follow from the 'private' nature of these references that they cannot be encoded in natural languages. It may simply be the case that, if we wanted to communicate these private references, we would have to spell out too many other thoughts concerning our life histories, which would be a practical obstacle rather than a theoretical impossibility. It seems then that further research is needed to establish the exact nature of the representations in the 'language of thought'.

The different proposals described above have in common that they all rest on the assumption that the output of the interpretation

process is some sort of representation. Recently this representational view of the mind has been challenged by the emergence of *connectionist* approaches to cognition (e.g. Rumelhart & McClelland, 1986; Smolensky, 1988). On the connectionist view, the mind consists of networks of interconnected processing units, nodes. Each node is connected to many other nodes, and the connections between nodes can either be excitatory or inhibitory. Input nodes get activated by different stimuli, other nodes get activated by their neighbours. Nodes send activation to their neighbours depending on their own level of activation. This means that there is no overall processor 'in charge', activation spreads automatically through the network.

One of the reasons that connectionist approaches have received a lot of attention is that it is claimed that they are biologically more plausible than representational approaches, because networks of nodes can be compared to clusters of neurons in the brain. However, as Sterelny (1990) points out, concerning the language of thought hypothesis:

> *"... it doesn't require that opening someone's head would reveal a tiny white-board with sentences written recognizably on it. Patterns of neural activity could well be sentential representations."* (Sterelny, 1990, p.24).

It may be the case that connectionist approaches give a better account of some processes than representational approaches. For example, connectionist approaches have been successful in modelling pattern recognition (e.g. Churchland, 1988). However, the question remains whether connectionism can account for all cognitive processes, and should replace the representationalist view of the mind.

Tanenhaus et al. (1987) argue for a connectionist approach to language input processing, such as the model developed by Cotrell (1985). This model proposes that during processing of a sentence like *Bob saw the cat*, the nodes for the concepts BOB1, SEE and CAT1 are activated (by, e.g. letter and feature nodes in the network). Of course, there cannot be nodes for complete sentences, because that would have as a consequence that there would be individual nodes for all possible sentences. Nor do the concept nodes together constitute a complete representation. Special *binding nodes* relate the concept nodes to thematic role nodes, to give a semantic representation of the sentence. Binding nodes also relate the concept nodes to nodes for syntactic constituents, to give a syntactic representation of the sentence. However, there are a number of problems with this sort of

approach. The most important one is the question of what is meant by a connectionist representation. As Sterelny (1990) points out:

> *"Given that the influence of node on node is local, given that there is no processor that looks at groups of nodes as a whole, it seems that seeing a distributed representation in a network is just an outsider's perspective on the system."* (Sterelny, 1990, p.188).

In other words, either collections of activated nodes can be combined into representations, in which case the connectionist approach to post-lexical processing is just an alternative implementation of the mental representation view, or they cannot be combined, in which case it has to be explained how the connections between concept nodes and binding nodes give us an interpretation of *Bob saw the cat* as *Bob saw the cat*, rather than *the cat saw Bob*.

The language of thought hypothesis at least gives us an explanation of structure-dependent processes, because it proposes structured representations. This does not mean that adopting the language of thought hypothesis rules out any connectionist explanations: it may well be that some of our cognitive processes are connectionist (for example, phonological form recognition), but that certain configurations of activated nodes map onto mental representations.

In order to get more insight in how an addressee achieves a full interpretation of a linguistic input, we need not only look at what kinds of representations are involved, but also at how the central systems involved in language comprehension operate.

One of the reasons why Fodor (1983, 1987,1990) advocates the modularity thesis, is his belief that central, non-modular systems are not amenable to study. Fodor (1983) says that:

> *"... though the putatively nonmodular processes include some of the ones that we would most like to know about (thought, for example, and the fixation of belief), our cognitive science has in fact made approximately no progress in studying these processes, and this may well be* because *of their nonmodularity."* (Fodor, 1983, p.38).

Fodor (1987) reinforces this point, in discussing the frame problem in artificial-intelligence. He argues that the frame problem and the problem of constructing a theory of nondemonstrative inference are essentially the same thing, and since he believes that such a theory is not in sight, he proposes that A.I. restrict itself to modelling encapsulated, i.e. modular processes. The problem with unencapsulated processes, Fodor argues, is the following:

> *"Suppose that, in pursuit of rational belief fixation, you undertake to subject whichever hypothesis might reasonably be true to scrutiny in light of whatever evidence might reasonably be relevant. You then have the problem of how to determine when demands of reason have been satisfied. You have, that is to say, Hamlet's problem: How to tell when to stop thinking."* (Fodor, 1987, p.26).

However, Sperber & Wilson (1986) point out that Fodor's pessimism concerning the feasibility of a theory of central processes stems from his taking scientific theorising as a typical example of a central thought process. They argue that the explicit standards of confirmation that a scientist applies to each piece of evidence in scientific theorising, may well be quite different from the way in which we make spontaneous, instantaneous and unconscious inferences in our every-day life. Sperber & Wilson propose that inferential comprehension may be a more typical example of a central process, and more amenable to study, because it differs from scientific theorising in a number of important respects. While scientific theorising is unconstrained as to how much time is spent, and how many hypotheses can be taken into consideration, this is not the case for utterance interpretation:

> *"... ordinary utterance comprehension is almost instantaneous, and however much evidence might have been taken into account, however many hypotheses might have been considered, in practice the only evidence and hypotheses considered are those that are immediately accessible."* (Sperber & Wilson, 1986, p.66).

Inferential comprehension also differs from scientific theorising in that communicators want their addressees to recognize their communicative intentions, which means that they construct their stimulus in a way that helps addressees to do this. The data for scientific theorising, on the other hand, do not come from a helpful source but have to be identified by the scientist. Sperber & Wilson argue that, because of these two facts, the study of inferential comprehension is more likely to give us an insight into central cognitive processing. They go on to present an approach to cognition and communication which is based on the considerations that comprehension is almost instantaneous, and that it is achieved with the active help of the communicator, Relevance theory.

1.4. Relevance theory.

Sperber & Wilson (1986) follow Fodor (1983) in viewing the output of the input systems as *logical forms*. However, within the framework of Relevance theory, logical forms are well-formed formulae in the language of thought, rather than linguistic representations. These logical forms can contain concepts and logical variables. When a logical form is semantically complete (i.e. when it contains only concepts, and therefore is capable of being true or false), it is called a *propositional form*.

Sperber & Wilson see concepts as psychological objects, considered at a fairly abstract level. Concepts consist of conceptual addresses, which give access to different types of information, logical, encyclopaedic and lexical. These different types of information may all play a role in the processing of logical forms. Concepts then have different entries for the different types of information:

> *"The logical entry for a concept consists of a set of deductive rules which apply to logical forms of which that concept is a constituent. The encyclopaedic entry contains information about the extension and/or denotation of the concept ... The lexical entry contains information about the natural language counterpart of the concept: the word or phrase of natural language which expresses it. ...information about its syntactic category membership and co-occurrence possibilities, phonological structure and so on."* (op. cit., pp.86, 90).

Sperber & Wilson argue that incomplete logical forms play an important role in cognition. They can be stored in memory as assumption schemas, which can be completed into propositional forms expressing factual assumptions, on the basis of contextual information. Also, the output of the language input system is often an incomplete logical form (see below), which the addressee has to complete into the fully propositional form the communicator intended to convey. Propositional forms, on the other hand, represent definite states of affairs. They constitute one's encyclopaedic knowledge, one's overall representation of the world.

Sperber & Wilson propose that one of our central systems is a deductive device, which differs from other central systems in the type of computation it performs. This deductive device is used in spontaneous inference and normal utterance comprehension, and makes use of elimination rules but not of introduction rules. These rules are stored in the logical entries of concepts and become available when their conceptual address is processed. Sperber & Wilson justify the

claim that only elimination rules are used by pointing out that only elimination rules are genuinely interpretive. The output assumptions of a deductive process involving only elimination rules explicate or analyze the content of the input assumptions, whereas the use of introduction rules leaves the content of the input assumptions unchanged, while adding arbitrary information. Sperber & Wilson see the formation of assumptions by deduction as the key process in non-demonstrative inference.

Postulating this deductive device goes some way towards explaining how spontaneous inference is constrained. However, it does not account for Fodor's claim that any piece of evidence may be taken into account. This brings us to the central claim of Relevance theory: Sperber & Wilson propose that in processing information, people try to achieve the greatest possible cognitive effect for the smallest possible amount of processing cost, i.e. that human cognition and communication is driven by relevance and the maximisation of relevance. In their theory, information is relevant to an individual if it yields contextual effects, i.e. if it interacts in a certain way with the individuals's existing assumptions about the world. Sperber & Wilson distinguish three different types of contextual effect: strengthenings, contradictions and contextual implications.

Assumptions can be held with different degrees of strength. A 'strengthening' of an assumption takes place if new information causes a person to have more confidence in an assumption already (weakly) held. New information may also contradict an existing assumption, in which case the weaker of the two assumptions is eliminated.

A contextual implication is defined as

> *"A set of assumptions {P} contextually implies an assumption Q in the context {C} if and only if*
> *(i) the union of {P} and {C} non-trivially implies Q,*
> *(ii) {P} does not non-trivially imply Q, and*
> *(iii) {C} does not non-trivially imply Q."* (op. cit., pp. 107-108).

While non-trivial implication is defined as

> *"A set of assumptions {P} logically and non-trivially implies an assumption Q if and only if, when {P} is the set of initial theses in a derivation involving only elimination rules, Q belongs to the set of final theses."* (op. cit., p. 97).

Relevance cannot be established purely in terms of contextual effects. Computing contextual effects involves processing effort, and since we do not have infinite processing resources, this means that the more

effort is required to work out the contextual effects of some phenomenon, the less relevant it is. Because of this, Sperber & Wilson define relevance as follows:

> a. *The greater the contextual effects, the greater the relevance.*
> b. *The smaller the processing effort, the greater the relevance.*

How does this notion of relevance help explain how language is interpreted? According to Sperber & Wilson people will only pay attention to information they think is relevant, or more relevant than any other information they could be attending to at that moment. For a communicator this means that her/his information should be relevant to the addressee. Because a communicator asks for the attention of the addressee, the addressee is entitled to assume that the communicator is trying to be relevant. Sperber & Wilson capture this in the principle of relevance, which says that:

> *"Every act of ostensive communication communicates the presumption of its own optimal relevance."* (op. cit, p. 158).

where the presumption of optimal relevance is defined as:

> *"a. The set of assumptions {I} which the communicator intends to make manifest to the addressee is relevant enough to make it worth the addressee's while to process the ostensive stimulus.*
>
> *b. The ostensive stimulus is the most relevant one the communicator could have used to communicate {I}."* (op. cit., p. 158).

Sperber & Wilson argue that the linguistic content of an utterance underdetermines its propositional content, i.e. a semantically complete logical form. They say that linguistic coding and decoding is involved in communication, but that the linguistic meaning of an utterance falls short of encoding what the speaker wants to communicate: the addressee can only take the output of the linguistic decoding process as a piece of evidence about the communicator's intentions. The output of the linguistic decoding process is taken to be an incomplete logical form, which the addressee then has to complete into the fully propositional form, which the communicator intended to convey. This process of enriching the incomplete logical form is a pragmatic process; points at which the logical form is incomplete have to be assigned values from the context, and this assignment is done in accordance with the principle of relevance.

This principle of relevance differs from Grice's (1975) Cooperative Principle and maxims in that:

> *"Grice's principle and maxims are norms which communicators and audience must know in order to communicate adequately. Communicators generally keep to the norms, but may also violate them to achieve particular effects; and the audience uses its knowledge of the norms in interpreting communicative behavior. The principle of relevance, by contrast, is a generalization about ostensive-inferential communication. Communicators and audience need no more know the principle of relevance to communicate than they need to know the principles of genetics to reproduce. Communicators do not 'follow' the principle of relevance; and they could not violate it even if they wanted to. The principle of relevance applies without exception."* (op. cit., p. 162).

In order to derive contextual effects, a context has to be found against which the information is to be processed. It has often been assumed that the context of an utterance is uniquely determined and that the relevance of the utterance is assessed against this context. Furthermore, it is assumed that the context is determined before the utterance is interpreted (e.g. Brown and Yule, 1983; Levinson, 1983). However, relevance theory proposes that an utterance communicates the presumption of optimal relevance. Because of this, the addressee can assume that the relevance of the utterance is given, and therefore need not be assessed. The task of the addressee is rather to select a context which bears out this guarantee of the relevance of the utterance.

How is this context selected ? Sperber & Wilson propose that at the start of processing some new item of information there is an initial context consisting of the assumptions left over in the memory of the deductive device from the immediately preceding deductive process. This initial context can be extended in different directions during the interpretation process. One way of extending the context is to add assumptions used or derived in previous deductive processes. A second way is to add assumptions stored under the encyclopaedic entries of concepts already present in the context or in the assumption being processed. A third way of extending the context is to add to it information about the immediately observable environment. However, extending the context involves processing cost, which means that an addressee cannot freely access all kinds of different extensions, because this would diminish the overall relevance of the assumption being processed.

Sperber & Wilson assume that there is a finite set of contexts[5], and that they are ordered in terms of accessibility. The initial context is immediately given. Extensions which only have the initial context as a sub-part can be accessed in one step, and are therefore the most accessible contexts; extensions which have the initial context and the one-step extension as sub-parts can be accessed in two steps and are therefore the next most accessible contexts, and so on.

The following picture of language comprehension then arises. The linguistic input maps onto an (incomplete) logical form. At points where the logical form is incomplete (e.g., where reference has to be assigned or in cases of ambiguity), this logical form has to be enriched into a fully propositional form. This process of enrichment is guided by the principle of relevance. Let us look at what this means in the case of lexical ambiguity, as in (1.15):

1.15. Susan went to the bank.

On hearing the ambiguous word *bank* all interpretations become available, e.g. (1.15a) and (1.15b):

1.15a. Susan went to the financial institution.
b. Susan went to the side of the river.

If speaker and hearer are discussing whether they have enough money available to pay the rent, then a context in which (1.15a) yields contextual effects is easily accessible, while a context in which (1.15b) yields contextual effects is less or not accessible. The hearer is then justified in going for the interpretation in (1.15a) as being the interpretation that the speaker intended, because it is consistent with the principle of relevance. Moreover, it follows from this that the first interpretation tested and found consistent with the principle of Relevance, is the only interpretation consistent with the principle of relevance: any further interpretation which yields contextual effects will automatically falsify the second part of the definition of relevance, because it will involve more processing cost, so that it is not optimally relevant.

In the case of structural ambiguity, Sperber & Wilson assume that the linguistic input is mapped onto a logical form up to the point of ambiguity. At that point the different possibilities are computed and a choice is made between them, again in accordance with the principle of relevance. Sperber & Wilson point out that processes such as reference assignment and disambiguation are not the only processes involved in computing a fully propositional form. Quite often, they

argue, semantic representations must be enriched, where this cannot be accounted for by the processes mentioned above.[6] As an example of this they compare (1.16) and (1.17):

1.16. I have had breakfast.
1.17. I have been to Tibet. (op. cit., p.189).

All that the linguistic input gives you is that the speaker has had breakfast (1.16), or has been to Tibet (1.17), at some time point within a period of time before the time of utterance. However, Sperber & Wilson argue that:

> *"In real life, a hearer would be expected to make some more or less specific assumption about how long that period was. In this, he is guided by the fact that a presumption of relevance has been communicated. In the case of [1.16], for example, it would normally go without saying that the speaker had had breakfast at some point in her life. If she intends her utterance to be manifestly relevant, she must intend to make manifest that she has had breakfast recently enough for it to be worth remarking on: for example, recently enough not to be in immediate need of food. In the case of [1.17], by contrast, the mere fact that the speaker had visited Tibet at some point in her life could well be relevant enough, and in the absence of more specific information this is the interpretation that would be consistent with the principle of relevance."* (op. cit., pp.189-190).

A consequence of Relevance theory is that there is no need to propose any specific principles to account for reference assignment and disambiguation, such as the principles proposed by Altmann & Steedman (1988). In the case of reference assignment, the following picture arises. An utterance containing a referential expression, analytically implies that the entity the expression refers to exists. Recovering this implication may be enough to yield adequate contextual effects. If this is not the case, then the addressee accesses the immediate context for a possible referent such that the resulting propositional form is consistent with the principle of relevance. If no such referent is found then the context is extended and the process is repeated. If no referent is found at all, then communication fails. This may cause the addressee to ask something like *What/who are you talking about?*

In cases of ambiguity, the addressee again goes for the interpretation that is consistent with the principle of relevance, as illustrated above. Sperber & Wilson argue that one of the few cases in which ambiguity is consciously perceived during the comprehension process, is the situation in which two different interpretations of an

utterance seem to come to mind simultaneously, and are both consistent with the principle of relevance. In cases like this, again communication will fail. In general, Relevance theory proposes that:

> *"At every stage in disambiguation, reference assignment and enrichment, the hearer should choose the solution involving the least effort, and should abandon this solution only if it fails to yield an interpretation consistent with the principle of relevance."* (op. cit., p.185).

1.5. Relevance theory and on-line comprehension.

With Relevance theory, we have a theory of pragmatics which not only accounts for how implicatures are worked out but also accounts for how the propositional content of the utterance is recovered. Sperber & Wilson give an account of how central systems involved in language comprehension operate, and of what kind of representations are used by these central systems. They propose that what a hearer recovers from the linguistic input is an incomplete logical form, which has to be enriched in various ways, until it yields a complete propositional form. However, they do not claim that this logical form has to be recovered completely, before any enrichments can take place. Processes such as reference assignment and recovery of elliptical material occur on-line. In the case of structural ambiguity, Sperber & Wilson propose that different possibilities are computed and chosen between, again on-line, in accordance with the principle of relevance. These proposals are motivated by the assumption that the sooner operations such as disambiguation and reference assignment are achieved, the less processing effort will be required:

> *"If processing costs were no object, the hearer could explore all possible parsings, disambiguations, illocutionary forces, reference assignments and enrichments. (...) This method of processing would guarantee that no conceivable interpretation would be overlooked, no possible context unexplored, and no possible contextual effect left underived. Clearly, however, it would also involve a lot of fruitless processing."* (op. cit., p.204).

In order to save a hearer from going through a lot of "fruitless processing", Sperber & Wilson propose that a speaker aiming at optimal relevance should phrase her utterance in such a way as to facilitate early, and correct, disambiguation. This raises the question of how a speaker can anticipate the way in which a hearer is going to interpret an utterance. Sperber & Wilson propose that the hearer makes anticipatory hypotheses about the overall logical structure of the

utterance, in a principled way, and that s/he resolves potential ambiguities and ambivalences on the basis of these hypotheses[7]. By virtue of being a hearer as well as a speaker, the speaker can anticipate what hypotheses the hearer is going to make, and structure his/her utterance accordingly.

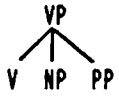
These proposals delimit the type of on-line comprehension model that is compatible with Relevance theory, and in particular rule out a serial autonomous model, such as the 'garden-path' model, discussed in section 1.1. The 'garden-path' model claims that the parser computes a single syntactic analysis of the linguistic input, purely on the basis of parsing principles; the context in which the input is processed cannot influence the initial analysis assigned by the parser. Since Relevance theory claims that context plays an essential role in disambiguation and other operations, this means that the two proposals make quite different predictions concerning the nature of on-line interpretation. Proponents of the 'garden-path' model claim that much experimental evidence supports their view of input processing, while no psycholinguistic experiments have been conducted which explicitly test the claims made by Relevance theory. This means that in order to assess whether the proposals made by Relevance theory concerning the interpretation process can be upheld in view of the experimental evidence, we have to address the question whether the claims of the 'garden-path' model are really borne out by this experimental evidence.

Chapter 2: The 'Garden-path' model.[1]

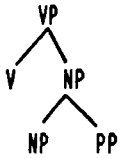
One view of the parser is that it computes an analysis on purely structural grounds, and that even in the case of syntactic ambiguity only one analysis is made, guided by structural criteria. (Frazier, 1978, 1987a, 1987b, 1987c; Frazier & Fodor,1978; Frazier & Rayner, 1982; Rayner, Carlson & Frazier, 1983; Ferreira & Clifton, 1986). Frazier (1978) proposes that the parser is guided by the principle of Minimal Attachment, which says that one does not postulate any (potentially) unnecessary nodes. This principle predicts that in the case of (2.1) the VP is analyzed as (2.1a) rather than (2.1b):

2.1. John hit the man with the stick.

(2.1a)



(2.1b)



A second criterion, proposed by Kimball (1973) as 'right association', by Ford et al. (1982) as 'final arguments', and by Frazier (1978, 1987a) as 'late closure', says that "*if grammatically permissible, new nodes are attached into the clause or phrase currently being processed (i.e. the phrase or clause postulated most recently).*" (Frazier, 1987a, p.562). This principle predicts that sentence (2.2) is analyzed as (2.2a), rather than (2.2b):

2.2. Joyce said Tom left yesterday.
  a. Joice said (Tom left yesterday).
  b. Joyce said (Tom left) yesterday.

These two principles have been incorporated in the 'garden-path' model of input processing. This model postulates that the parser computes syntactic representations using the rules of the grammar but governed by the principles of Minimal Attachment and Late Closure. Frazier (1987a) says about these principles:

> *"let me emphasize that the Minimal Attachment and Late Closure strategies are not arbitrary, e.g., one can understand why different individuals should each adopt these particular strategies and not, say, their inverses. Both Minimal Attachment and Late Closure may be viewed as the result of adopting the first analysis available to the processor. (...) Assuming the need to structure material quickly is related to restrictions on human immediate memory capacity, we might expect all humans to adopt the first available constituent structure analysis. If so, we expect the Minimal Attachment and Late Closure strategies to be universal."* (op. cit., p.564-565).

However, as we saw in chapter 1, the model makes different predictions depending on what kind of phrase structure rules the parser uses, i.e. 'simple' phrase structure rules, or richer phrase structure rules such as proposed in X'-theory.

The experimental findings that have been presented in support of the 'garden-path' model either concern the principle of Minimal Attachment, or the principle of Late Closure. I will therefore evaluate the experimental evidence for the two principles separately.

2.1. Minimal Attachment

Minimal Attachment has been used as an explanation for the 'garden-path' effect, observed in sentences like:

2.3. The horse raced past the barn fell.

Here Minimal Attachment causes 'the horse raced past the barn' to be taken as a main clause, rather than a complex NP.

Rayner et al. (1983) report two experiments conducted to examine whether there are effects of semantic and pragmatic information on the syntactic analysis of ambiguous sentences. Rayner et al. assume that ambiguous sentences will be analyzed according to Minimal Attachment, so that they do not expect any semantic or pragmatic effect. In the first experiment, subjects read sentences like the following, while their eye movements were recorded:

2.4a. The florist sent the flowers was pleased.
b. The performer sent the flowers was pleased.
c. The performer who was sent the flowers was pleased.
d. The performer sent the flowers and was very pleased with herself.

The assumption behind these sentences is that florists are expected to send flowers rather than receive them, whereas it is more plausible that performers receive flowers rather than send them. Rayner et al. say that:

> *"If the language processor initially adopts the pragmatically most plausible analysis of a string, then readers should be garden-pathed in the implausible sentences [2.4a] and [2.4d], but not in the plausible sentences [2.4b] and [2.4c]. By contrast, if the processor initially follows its structural preference for assigning the minimal necessary syntactic structure to a string (...) without regard for the relative pragmatic plausibility of this analysis, then readers should be garden-pathed in sentences [2.4a] and [2.4b], but not in [2.4c] or [2.4d]."* (Rayner et al., 1983, p.361).

Rayner et al. found that plausibility did not affect the syntactic analysis of the different sentences. Readers were garden-pathed both in implausible sentences like (2.4a) and plausible sentences like (2.4b), but not in active implausible sentences like (2.4d). These results are taken to indicate that only a single syntactic analysis of a sentence is initially computed (if all syntactic analyses of a sentence were initially computed, readers would not have been garden-pathed), and that this analysis is not guided by pragmatic constraints.

These conclusions, however, are not as inevitable as it may at first appear. The term 'pragmatic plausibility' is not defined. For instance, we are just told that the reduced relative reading of a sentence like (2.4b) involves the most plausible assignment of thematic relations on pragmatic grounds. Consider, however, the following sentence:

2.5. The performer sent flowers to her director to thank him for his patience with her.

It is hard to see what is pragmatically implausible about the action expressed in this sentence.

Bever (1970) found that the garden-path effect in (2.6a) disappeared, when 'the authors' was replaced by an NP which could not be interpreted as an agent, as in (2.6b):

2.6a. The authors read in the garden stank.
2.6b. The articles read in the garden stank.

It seems that the implausibility of inanimate objects being involved in an act of reading is of a different nature than the implausibility of performers sending rather than receiving flowers: no plausible continuation of (2.6b) can be found, unless one really stretches one's imagination (e.g., in a fantasy or s.f. story).[2] However, the finding that the garden-path effect disappears in these sentences suggests that processing these sentences is sensitive to semantic information, because if it were not, we would expect that subjects would be garden-pathed even in sentences like (2.6b).

Although Rayner et al. set out to test whether pragmatic information has an effect on syntactic analysis, they do not take into account that the use of restrictive relative clauses is governed by pragmatic considerations. The function of restrictive relative clauses is to narrow down or restrict the meaning of a noun (cf. for example, Leech & Svartvik, 1975). Restrictive relative clauses can therefore help an addressee identify the referent(s) of an NP. For

example, sentence (2.4b) could help an addressee identify a particular performer in a situation\context where there are several performers, one of whom has been sent flowers. However, in the experiment subjects read sentences in isolation. When the subjects encounter the first NP (e.g. *the performer*) they can establish from the definite article that the sentence involves a particular performer, but they won't be able to identify which performer is meant. Nor can they expect that more information will help them identify the performer, since there is no context for the sentence. In fact, in order to accommodate the restrictive relative clause in the interpretation of the sentence, the reader has to make the extra assumptions that there is a group of performers, and that one of them received flowers, which means an increase in processing load. Because of this, the main clause reading of a sentence like (2.4b) is actually pragmatically the most plausible in view of the extra amount of processing that postulating a restrictive relative clause involves.[3] Rayner et al.'s findings therefore do not in fact constitute any evidence for the Minimal Attachment strategy.

Crain & Steedman (1985) note in respect to restrictive relatives that:

> *"The use of a referential definite like 'the horse which was raced past the barn' presupposes (among other things): 1) that a set of individuals identified by the head nominal (in this case a set of horses) is already represented in the hearer's model; 2) that it is already given or implicit that the relative clause applies to some individual in that set; 3) that the whole expression identifies a <u>single</u> individual. (...) indefinites like 'a horse which was raced past the barn' need presuppose none of these things. One can use the latter phrase if no particular set of horses has been mentioned, whether or not the question of racing has been raised, and of course there is no implication that there is only one individual who fits the description."* (Crain & Steedman, 1985, pp.335-336).

Crain & Steedman report on an experiment they conducted to determine what kind of semantic and pragmatic information is called on by the parser. In this experiment they used test sentences like the following:

2.7a. The teachers taught by the Berlitz method passed the test.
b. The children taught by the Berlitz method passed the test.
c. Teachers taught by the Berlitz method passed the test.
d. Children taught by the Berlitz method passed the test.

They found that the (b) and (d) sentences were judged grammatical significantly more often than the (a) and (c) sentences. This result is similar to the findings of Bever (1970) (see above).[4] Moreover, Crain & Steedman found that the indefinite sentences (c) and (d) were judged grammatical significantly more often than the definites (a) and (b). These results together with Bever's (1970) results argue against Minimal Attachment, because structurally there is nothing to distinguish (2.6a) and (2.6b), and the sentences in (2.7) from one another.

Crain & Steedman also report on an experiment they conducted to determine the effect of context on parsing structurally ambiguous sentences. Minimal pairs of contexts were constructed to induce either relative or complement readings of locally ambiguous sentences. They used materials like the following:

2.8a. Complement-inducing context

A psychologist was counselling a married couple. One of the pair was fighting with him, but the other one was nice to him.

b. Relative-inducing context

A psychologist was counselling two married couples. One of the couples was fighting with him, but the other was nice to him.

c. Complement target sentence

The psychologist told the wife that he was having trouble with her husband.

d. Relative target sentence

The psychologist told the wife that he was having trouble with to leave her husband.

Crain & Steedman found that the subjects were garden-pathed about equally often in both contexts when the completing phrase was inconsistent with the context, but that garden-path effects largely disappear when the completing phrase is consistent with the context. They concluded that:

> *"The experiments presented here suggest that there may be no intrinsically garden-pathing structures whatever, but rather that, for any given sentence, there are certain contexts (including the null context) which induce garden paths and others that do not. We have also argued that such evaluations can be made well before the sentences are complete. The fact that the contextual cues seem to be used during the first pass through a sentence, often before the last words have been encountered at all, is important. (...) it (...) appears to be incompatible with non-*

> *interactive processing of syntax, even in a "modified" version limiting interaction to the level of major phrases, at least on the reasonable assumption that the corresponding representationally autonomous units provide the input to semantic interpretation, for such models do not explain how the effects could be found before the constituent is complete."* (Op.cit., pp.345-346).

Ferreira & Clifton (1986) point out that Crain & Steedman's experiments did not use an on-line measure of sentence processing. They say that because of this it cannot be determined whether the disappearance of the 'garden path' effect is caused by initial (or early) use of semantic information and the context, which argues against the minimal attachment strategy. It could be due to later use of semantic information and the context, which does not rule out an initial minimal attachment analysis. They conducted three experiments to find out whether semantic content or pragmatic context can direct the initial syntactic analysis assigned to sentences. In the first experiment eye movements were recorded to assess the on-line operation of the parser when it has available thematic information that biases the interpretation of a syntactic string. Materials like the following were presented in isolation:

2.9a. The defendant/ examined/ by the lawyer/ turned out/ to be unreliable. (animate, reduced).

b. The evidence/ examined/ by the lawyer/ turned out/ to be unreliable. (inanimate, reduced).

c. The defendant/ that was/ examined/ by the lawyer/ turned out/ to be unreliable. (animate, unreduced).

d. The evidence/ that was/ examined/ by the lawyer/ turned out/ to be unreliable. (inanimate, unreduced).

The slashes give the relevant phrases of the sentences: c-2 (c for critical), c-1, c (= by the lawyer), c+1, and c+2.

Ferreira & Clifton found that the reduced relative sentences gave rise to increased reading times in the disambiguating *by* phrase region, which reflects that subjects were garden-pathed. They found that this was the case not only for the reduced relatives which have an animate subject, but also for the reduced relatives with an inanimate subject. Because the inanimacy of the subject NP should block the Minimal Attachment analysis if it were taken into consideration, Ferreira & Clifton conclude that subjects did not use semantic information to guide the syntactic analysis.

However, when we look at the Mean First Pass reading times (see below), we see that the results obtained by Ferreira & Clifton are open to a different interpretation.

Mean First Pass Reading Times per character (in ms.)

	c - 1	c	c + 1
Animate Reduced	33.3	40.4	31.9
Animate Unreduced	31.9	30.7	33.1
Inanimate Reduced	37.7	38.4	32.6
Inanimate Unreduced	30.1	30.3	28.6

These reading times show that the animate reduced sentences were indeed subject to the difficulty in the disambiguating 'c' region, reflecting garden-pathing. This is to be expected under a Minimal Attachment strategy as well as under a semantically directed strategy. When we look at the reading times for the inanimate reduced sentences, we see that although the reading time in the 'c' region is significantly higher than the reading times for the unreduced sentences in this region, the reading time in the 'c-1' region (e.g., 'examined') is also significantly higher than for the other three sentences types, whereas there is only a 0.7 difference between the 'c-1' and 'c' reading times for these inanimate reduced sentences. Ferreira & Clifton say that:

> *"Reading times for the first verb (region c-1) were long when the verb followed the inanimate NP, indicating that readers were sensitive to the fact that the preferred analysis resulted in an anomaly. This fact indicates that eye movements are sensitive in an immediate fashion to syntactically sensitive anomaly effects, providing further evidence for rapid on-line comprehension of sentences. (...) Nonetheless, the readers apparently did not resolve this anomaly on a semantic basis, but instead waited for syntactic information."* (op. cit., p.355).

Altmann & Steedman (1988) note about this that:

> *"If a simplex NP analysis, that is pragmatically favoured by the null context is also comparatively implausible (...) then the effect of the anomaly will show up immediately. However, unless the simplex reading is a complete semantic impossibility (as seems to be the case with Bever's 'articles read ...') it will not override the pragmatic preference, and the analysis will be pursued until the syntactic anomaly is encountered."* (Altmann & Steedman, 1988, p.213).

Altmann & Steedman point out that most of the sentences in this experiment can be given a fairly plausible interpretation up to the disambiguation point, for example, *The car towed ...* could be followed by *a minivan.* This means that, for most of the materials used,

initial use of semantic information and context did not bias the reader against the minimal attachment analysis, but rather the opposite: since the sentences were presented in isolation there was nothing in the context to encourage the reader to make any extra assumptions, needed for the reduced relative reading. Furthermore, some of the verbs that were used do not in fact cause an anomaly in combination with inanimate NPs at all, but rather allow for different argument structures. For example, *feel*, which Ferreira & Clifton used in the sentence in (2.10a), can also appear with just a theme as in (2.10b):

2.10a. The skin (that was) felt by the blind man was very soft and delicate. (actor, theme).

b. The skin felt very soft.

Smell, which Ferreira & Clifton used in (2.11a), can also appear with just a theme as in (2.11b):

2.11a. The trash smelled by the dog was laying on the sidewalk. (actor, theme)

b. The trash smelled awful/ of rotten eggs.

In these cases there is no reason at all for the reader to consider a reduced relative reading, although accessing the two possibilities and choosing between them may be responsible for an increased reading time here. This means that these findings do not constitute evidence for the use of a Minimal Attachment strategy.

Ferreira & Clifton (1986) conducted a further two experiments to determine whether contextual information can direct the initial analysis assigned to sentences. They used two sets of target sentences, like the following:

2.12a. The editor played the tape agreed the story was big.

b. The editor played the tape and agreed the story was big.

2.13a. Sam loaded the boxes on the cart onto the van.

b. Sam loaded the boxes on the cart before his lunch break.

These were presented in a variety of contexts, i.e. a Non-Minimal Attachment (NMA) inducing context followed by a NMA target (e.g. 2.12a), a MA inducing context followed by a MA target (e.g. 2.12b), a Neutral context followed by a NMA target, and a Neutral context followed by a MA target. Ferreira used an on-line eye movement measure for the second experiment, and the third experiment was a paced reading task (only involving type 2.12 sentences). In the second experiment, they found that the results for the reduced relatives were

only marginally significant. They conclude that the results indicate that Non-minimal sentences take longer to read than Minimal Attachment sentences, because the difference in reading times occurred in the regions after the disambiguation region, and was not influenced by context. These findings then seem to confirm that syntactic processing takes place regardless of contextual information.

Altmann & Steedman (1988) point out that Ferreira & Clifton's results are based on the assumptions that MA and NMA sentences require the same processing times, and that their contexts were felicitous with respect to the assumptions that had to be made for each target sentence. They say that one possible explanation of the fact that the NMA sentences took longer than the MA sentences is that it is quite unlikely that MA and NMA sentences take the same processing times:

> *"This is because of the extra work required for the NMA sentences in order to infer that "the editor played the tape" has as its antecedent the editor mentioned in "he ran a tape for one of his editors". (...) Ferreira & Clifton (1986) reject this as a possible objection, because, they claim, any such difference should show up on the ambiguous noun-phrase, and not, as they find, on the following (disambiguating) material. (...) However, according to Ehrlich and Rayner (1983, p.84):*
>
> *"...more complex processes [than lexical retrieval and some syntactic parsing] such as those involving integration are not necessarily completed during the fixation on which the process was initiated (...)."*
>
> *So the observed increases in reading time in the disambiguating regions could (and most likely do) reflect integrative processes concerned with the evaluation of the preceding noun-phrase, rather than syntactic reanalysis."* (Altmann & Steedman, 1988, pp.214-215).

Moreover, they note that what Ferreira & Clifton claim to be a strictly neutral context, in fact biases towards a MA analysis:

> *"In the "neutral" context below, which Ferreira and Clifton used in conjunction with [2.12] above, a number of potential referents are introduced ("his editors"). Ferreira and Clifton claim that this satisfies Crain and Steedman's (1985) requirement that more than one editor is mentioned (which is felicitous with the reduced relative interpretation). But in order to ensure felicity with the minimal attachment interpretation, one of these potential referents for the ambiguous noun-phrase is then "foregrounded" (...):*
>
> *"(...) He went to his editors with a tape and some photos because he needed their approval before he could go ahead with the story. He brought out a tape for one of his editors and told him to listen carefully to it. The editor played the tape (and) agreed the story was big."*

> *However, in making the minimal attachment felicitous, this also has the effect of making the restrictive modification infelicitous."* (op. cit., p.216).

Furthermore, Altmann & Steedman point out that:

> *"the presuppositions associated with specifically past-participle reduced relatives are extremely complex and ill-understood. These presuppositions are particularly difficult to control experimentally (Crain, personal communication, 1988; Forster, personal communication, 1988), and are not among the constructions actually used by either C & S or the present authors in experiments manipulating context."* (op. cit., p.216-217).

Ferreira & Clifton's findings are clearly open to reinterpretation and, therefore, they do not constitute decisive evidence for the independence of syntactic processing, as envisaged in the 'garden-path' model.

Frazier (1987b) uses two sets of findings to illustrate why she thinks that empirical evidence supports the 'garden-path model' (Minimal Attachment and Late Closure). She discusses an experiment conducted by Frazier & Rayner (1982), in which they recorded the eye-movements of subjects reading sentences like the following:

2.14a. John knew the answer to the physics problem by heart.
b. John knew the answer to the physics problem was easy.

Their data showed increases in fixation durations and reading time in the disambiguating region of nonminimal-attachment sentences like (2.14b), which they take to be evidence for a minimal attachment strategy: the second NP is minimally attached as the direct object of the verb 'knew', so that reanalysis has to take place when subjects encounter the disambiguating region.

Frazier (1987b) also discusses her (1987c) experiments in Dutch, a partially head-final language. In one of the experiments, Frazier (1987c) presented subjects with ambiguous sentences such as (2.15), using self-paced frame-by-frame reading times as a measure of complexity:

2.15. Jan houdt niet van [de Amerikaanse die de Nederlander wil uitnodigen].
(John likes not from the American who the Dutchman wants invite)
a. John doesn't like the American who wants to invite the Dutch person.
b. John doesn't like the American who the Dutch person wants to invite.

Frazier found that in ambiguous sentences like (2.15), the interpretation in (2.15a) is preferred over the interpretation in (2.15b).

She also presented subjects with unambiguous object relatives and unambiguous subject relatives, such as those in (2.16), and found that reading times for unambiguous object relatives were longer than for unambiguous subject relatives. It should be noted, however, that the sentences in (2.16) are ambiguous up until the final verb (i.e. zoeken/zoekt):

2.16a. Subject relative.

Wij kennen /[de meisjes die de jongen zoeken].
We know the girls who the boy search
(We know the girls who are looking for the boy.)

b. Object relative.

Wij kennen /[de meisjes die de jongen zoekt].
We know the girls who the boy searches
(We know the girls whom the boy is looking for.)

To account for these findings, Frazier (1987c) proposes that the principle of Minimal Attachment operates in Dutch as well as in English. Frazier (1987b) says that the experimental findings from Frazier & Rayner (1982) and from Frazier (1987c) are difficult to explain without appealing to general structural-preference principles. However, another explanation, without appeal to such principles is available. When we look at Frazier's test sentences we see that in both the type (2.14) sentences and the type (2.15/2.16) sentences the difference between the minimally attached and non-minimally attached sentences is not just a difference in structure. When processing sentence (2.14b) the reader does not only have to postulate that John knew *something*, but also will have to make the extra assumption that it was something *about* the answer that John knew, rather than just *the answer*. Because the sentence is processed in isolation, there is nothing in the context that would induce the reader to make this extra assumption.

In sentence (2.15) the relative pronoun *die* (which cannot be deleted in Dutch) signals that a subordinate proposition will follow, so that the reader can make the assumption that some more information about *de Amerikaanse* will follow. However, in order to get the object relative reading, the reader will have to make an extra assumption, namely that *de Amerikaanse* is the object of an event involving somebody

else, which implies a shift in focus; something the reader does not have to do in order to get the subject relative interpretation. Frazier found that with object relatives as in (2.16), the head of the relative was incorrectly identified as the subject of the relative clause 31% of the time. On the view that in order to get an object relative interpretation the reader would have to make an extra assumption (which is not supported by the context, since the sentences were presented in isolation), this could be expected, since the sentences in (2.16) are ambiguous up until the last disambiguating verb.[5]

Another experiment that Frazier (1987c) conducted in order to test the cross language validity of her processing model, involved sentences like:

2.17. Ik weet dat de man in Holland investeert.
(I know that the man in Holland invests)
= a) I know that the man invests in Holland.
or: b) I know that (the man in Holland) invests.

Frazier found that the preferred reading of (2.17) is (2.17a), rather than (2.17b), which she explains by saying that the parser operates on the principle of Minimal Attachment in Dutch, as well as in English. However, as was the case with the Rayner et al. (1983) test sentences discussed above, in order to get the (2.17b) interpretation, the reader not only has to establish that the sentence involves a specific man, but also has to make the extra assumptions that there is a group of men and that the whole expression refers to one individual in that group. Since the sentence is presented in isolation there is nothing in the context to encourage the reader to make these extra assumptions. This means that the (2.17a) interpretation is pragmatically the most plausible interpretation, in view of the extra amount of processing that making extra assumptions involves.

Frazier & Rayner (1987) report on three experiments which they conducted in order to test the effects of interaction of lexical and syntactic processes during language comprehension. Eye movements were recorded during the reading of sentences containing syntactically ambiguous lexical items, such as 'warehouse fires', where *warehouse* can be a noun or an adjective, and *fires* can be a verb or a noun. They used materials like the following:

2.18a. The warehouse fires numerous employees each year.
b. The warehouse fires harm some employees each year.

2.19a. This warehouse fires numerous employees each year.

b. These warehouse fires harm numerous employees each year.

The aim of these experiments was to test alternative hypotheses about how the parser resolves these syntactic category ambiguities, the first analysis strategy, the multiple analysis strategy, and the delay strategy. The first analysis strategy predicts that the processor will go for the first available analysis of an input; the multiple analysis strategy predicts that the processor will compute different analyses in parallel; and the delay strategy predicts that the processor will delay assigning an analysis until it receives disambiguating material.

Frazier & Rayner argue that if the processor immediately adopts the first analysis of *warehouse*, this will result in *warehouse* being categorized as a noun. That will have as a consequence that *fires* will be analyzed as a verb, because that is the only analysis consistent with the analysis of *the warehouse* as an NP. This means that the first analysis strategy predicts that the adjective–noun forms in (2.18b) and (2.19b) will take longer to process than the noun–verb forms in (2.18a) and (2.19a), because only the adjective–noun forms will lead to reanalysis.

Frazier & Rayner go on to say that they have reasons for expecting that the principles governing the analysis of categorially ambiguous strings differ from the principles governing unambiguous or already categorized strings. They point to studies of lexical access, which support the view that all meanings of an ambiguous word are activated, even in circumstances where preceding syntactic context disambiguates a categorially ambiguous item (Prather & Swinney, 1979; Seidenberg et al., 1982; Tanenhaus & Donnenwerth-Nolan, 1984). Frazier & Rayner say that:

> *"If all entries associated with an ambiguous lexical item are automatically activated and made available for purposes of syntactically structuring an input sentence, the processor need not perform any active computations to determine that it is at a choice point where there may be more than one well-formed analysis of the input. In short, the existence of more than one (local) analysis might be determined effortlessly as an automatic consequence of the normal operation of the lexical access mechanisms."* (Frazier & Rayner, 1987, p.506-507).

Based on this one can postulate that the processor follows a 'multiple analysis strategy', i.e. that the processor makes more than one analysis of categorially ambiguous strings until disambiguating

material is encountered. Frazier & Rayner argue that the 'multiple analysis strategy' predicts that there will be an increase in the complexity of processing categorially ambiguous items, because the processor will have to construct different syntactic analyses and actively maintain them in memory. This means that each analysis of an ambiguous word must be compared with the different analyses assigned to preceding material to determine which continuation of the sentence fragment is permissible. Frazier & Rayner argue that this means that the 'multiple analysis strategy' predicts that:

> *"... the ambiguous sentence forms in [2.18] (...) take longer to process than the corresponding forms in [2.19], where the determiner 'this' or 'these' provides advance disambiguating information which would alleviate the need to maintain any but the correct analysis of the ambiguous string."* (op.cit., pp.506-507).

However, when we look at sentence (2.19a) we see that the determiner *this* does not in fact provide *"advance disambiguating information which would alleviate the need to maintain any but the correct analysis of the ambiguous string"*; when *this warehouse* is accessed, it could still be followed by either the verb *fires*, or by a noun, e.g. *fire*, as in *This warehouse fire was worse than any we have had here.* The difference between this sentence and the sentences in (2.18) is that the disambiguation can take place when the third word is accessed, rather than the fourth or fifth word (*harm* in (2.18b) is again ambiguous between a noun and a verb reading).

It is a question whether a multiple analysis strategy indeed predicts that the ambiguous sentence forms in (2.18) take longer to process than the corresponding forms in (2.19). Although in (2.19a) the ambiguity can be resolved earlier than in the (2.18) sentence forms, and in (2.19b) only one analysis has to be maintained, the different entries of the categorially ambiguous lexical items will be accessed and a choice between the different entries will have to be made. This may offset the time needed to maintain two representations in memory, or even take more time:

```
the adj(warehouse) ...   ==> the adj(warehouse) noun(fires) ...
the noun(warehouse) ...  ==> the noun(warehouse) verb(fires) ...

this adj(warehouse) ...  ==> *this adj(warehouse) noun(fires) ...
this noun(warehouse) ... ==> this noun(warehouse) verb(fires) ...

*these noun(warehouse) ...
these adj(warehouse) ... ==> these adj(warehouse) noun(fires) ...
                         ==> *these adj(warehouse) verb(fires) ...
```

The third strategy that Frazier & Rayner postulate, the delay strategy, predicts that the parser delays syntactic integration of categorially ambiguous items until disambiguating material is encountered:

> *"The delay strategy predicts that processing the ambiguous words 'warehouse fires' should take longer in the disambiguated sentence forms in [2.19] than in the ambiguous sentence forms in [2.18], assuming decisions about the syntactic analysis of these words takes time, since these decisions will be accomplished as the ambiguous words are encountered in [2.19], but not in [2.18]. However, according to the delay strategy, the region following the ambiguous words should be associated with longer reading times in [2.18] than in [2.19], since in the ambiguous sentence forms in [2.18] the syntactic analysis of the ambiguous words will be accomplished only in this region of the sentence, i.e. once the the disambiguating information is encountered."* (op. cit., p.507).

Frazier & Rayner conducted two experiments to test the different hypotheses. In the first experiment sentences like (2.18) and (2.19) were presented. The noun–verb ambiguous words in experiment 1 had two semantically unrelated meanings (e.g. *fires*). In order to determine whether different patterns of results would be obtained when there was a systematic relationship between the meanings of the ambiguous words (e.g., *swing*), experiment 2 was run, testing sentences like the following:

2.20a. Some of us weren't aware that the church pardons very few people. (N–V ambiguous).

b. Some of us weren't aware that the church pardons are difficult to obtain. (A–N ambiguous)

c. Some of us weren't aware that this church pardons very few people. (N–V disambiguated)

d. Some of us weren't aware that these church pardons are difficult to obtain. (A–N disambiguated).

Frazier & Rayner claim that the results of experiment 1 provide clear evidence for the delay strategy:

> *"Both the multiple analysis strategy and the delay strategy are consistent with the finding that reading times in the disambiguating region were longer in the ambiguous sentence forms than in the disambiguated sentence forms but only the delay strategy predicted that reading times for the two ambiguous items should take longer in the disambiguated forms than in the ambiguous forms."* (op. cit., p.511).

This claim rests on the assumption that with the multiple analysis strategy the reading times for the ambiguous items take longer in the ambiguous forms than in the disambiguated forms. However, when we look at the reading times that Frazier & Rayner found in the first experiment, we see that this assumption is not very well supported:

Average Reading Time Per Character (in msecs.) for Ambiguous words and for the Remainder of the Sentence in Experiment 1

	Word order			
Syntactic class	1st	2nd	X	Remainder
Ambiguous				
N-V	35 (219)	48 (237)	41.5(228)	46
A-N	38 (230)	52 (258)	45 (228)	49
X	36.5(225)	50 (247)	43 (236)	47.5
Disambiguated				
N-V	39 (234)	52 (259)	45.5(247)	43
A-N	46 (263)	50 (248)	48 (255)	44
X	42.5(249)	51 (253)	47 (251)	43.5

Note. Average gaze duration (in msecs.) is presented in parentheses. (op. cit., p.511).

The reading time increases at the second ambiguous word in the disambiguated N-V sentences, and at the first ambiguous word in the disambiguated A-N sentences. This was to be expected, since the disambiguation takes place at these points. The reading time is also high at the second ambiguous word in the disambiguated A-N, which may be due to the fact that again a choice must be made between the two readings of the word. However, reading times also increase at the second ambiguous word in the ambiguous sentences, as much as in the disambiguated N-V sentence. Frazier & Rayner say about this:

> *"The generally longer reading times for the second of the two target words might be due to any of a variety of factors (including, for example, the particular lexical items tested, serial position effects, a reflection of ongoing semantic processing in the disambiguated forms offset by some advance disambiguation in the ambiguous forms in cases where readers were exploiting perceptual information about the following word, etc.)."* (op. cit., p.512).

On the view that multiple analyses are made, the fact that the increase in reading time occurs at the second ambiguous word in ambiguous sentences can be explained by postulating that the reader must accommodate the two readings of the word in the two analyses s/he already has. On the other hand, if it is the case, as Frazier &

Rayner say, that some advance disambiguation takes place in cases where readers were exploiting perceptual information about the following word, we would expect this not only to show up at the second of the two target words in the ambiguous sentences, but also at the first target word of the 'disambiguated' N-V sentences. The first target word in the 'disambiguated' N-V sentences is ambiguous and gets disambiguated by the second target word. Therefore, when we compare the reading times for the first target words in the ambiguous sentences, where no advance disambiguation can take place, with the reading time for the first target word in the 'disambiguated' N-V sentences, where some advance disambiguation can take place, we would expect a significant difference. However, Frazier & Rayner do not find a significant difference between the ambiguous sentences (35/38 msecs.) and the disambiguated N-V sentences (39 msecs.).

The results of their second experiment are very similar to those of the first experiment:

Average Reading Times Per Character (in msecs.) for the Ambiguous Words and for the Remainder of the Sentence in Experiment 2

	Word Order			
Syntactic class	1st	2nd	X	Remainder
Ambiguous				
N-V	34 (214)	43 (257)	38.5(236)	52
A-N	34 (214)	41 (245)	37.5(230)	50
X	34 (214)	42 (251)	38 (233)	51
Disambiguated				
N-V	37 (234)	44 (261)	40.5(248)	38
A-N	39 (240)	41 (246)	40 (243)	49
X	38 (237)	42.5(253)	40.25(246)	42

Note. Average gaze duration (in msecs.) is presented in parentheses.

Frazier & Rayner say about these results:

> *"There was, however, one interesting difference that emerged in the pattern of results in Experiment 2. In sharp contrast to Experiment 1, adjective-noun forms did not take longer to read than noun-verb forms in terms of total reading time (...). This result strongly suggests that the relative complexity of the adjective-noun forms in Experiment 1 was not due simply or directly to the derivative adjectival categorization of the first ambiguous item, but rather was due to the unconstrained semantic relation between the adjective and noun in Experiment 1. (...) In short, the relative complexity of adjective-noun sentences in Experiment 1 may be attributed to the need to construct a salient semantic relation between the adjective*

and noun without the benefit of thematic constraints." (op. cit., pp.513-514).

However, Frazier & Rayner cannot have it both ways. On Frazier & Rayner's view, semantic processing only starts after a syntactic structure is assigned. On the delay strategy hypothesis, no structure is assigned to the ambiguous sentences until the point of disambiguation. They explain the increased reading times for the second ambiguous word in the ambiguous sentences by saying that they may be due to a variety of factors, including some advance disambiguation in the ambiguous forms. However, when we compare the results for the ambiguous sentence forms of Experiment 1 and Experiment 2, we see the following difference:

	Word Order			
Syntactic class	1st	2nd	X	Remainder
Experiment 1				
N-V	35 (219)	48 (237)	41.5(228)	46
A-N	38 (230)	52 (258)	45 (228)	49
Experiment 2				
N-V	34 (214)	43 (257)	38.5(236)	52
A-N	34 (214)	41 (245)	37.5(230)	50

If the increase at the second ambiguous word is caused by serial position effects, or some advance disambiguation, then we can't explain how there can be such a difference between increase in reading time in the ambiguous A-N sentence forms in Experiment 1 (14 msecs. per character), and in Experiment 2 (7 msecs. per character). If, however, this difference is due to semantic processing, as Frazier & Rayner suggest above, this implies that one or more syntactic structures have already been assigned since, on their view, semantic processing only takes place after a syntactic structure has been assigned. But this goes against the delay strategy hypothesis which claims that no structure is assigned until the point of disambiguation. These findings then actually favour a multiple analysis strategy over a delay strategy, since only the multiple analysis strategy makes syntactic structures available to semantic processing and evaluation.

Frazier & Rayner say that their findings clearly favour the delay strategy but this conclusion rests on the assumption that a multiple analysis strategy requires more processing time than resolving ambiguities. Furthermore, their findings present several problems for the delay strategy which they do not account for. Frazier & Rayner suggest that the human language processor is characterized by the following general principles:

> *"when a representation must be computed by rule, the processor adopts the first analysis available to it; when representations are precomputed, the processor considers the alternatives available to it and then selects and computes all of the (global) structural consequences of just a single analysis; and selection from among prestored alternative analyses is delayed just in case helpful information is more likely to arrive immediately than further downstream."* (op.cit., p.522).

This view of the processor raises a number of questions. On this view the processor automatically assigns a syntactic structure to incoming material, unless there is a categorial ambiguity. In the case of a categorial ambiguity it delays analysis until disambiguating material arrives. Furthermore, it has to make guesses about the likelihood of the immediate arrival of 'helpful information'. The 'garden-path' model gives no explanation of how the processor hypothesizes about this likelihood. Also, Frazier & Rayner do not account for how the processor goes about assigning an analysis in case the helpful information is more likely to arrive 'further downstream': does this happen according to some principle, or arbitrarily? Nor is it clear why the parser delays analysis in the case of syntactic category ambiguity, but pursues a Minimal Attachment strategy in the case of, for example, a simple past vs. a participle form of a verb (*The horse raced past the barn fell*). All Frazier & Rayner say about this is that:

> *"The question immediately arises why the language processor delays analysis of an input under some circumstances (syntactic category assignment, thematic frame selection) and adopts the first available analysis under others (assigning a syntactic structure to lexically categorized items). Apparently in circumstances where developing an analysis of an input involves active computation of a representation (as is necessary in the case of syntax, since the syntactic structures of a language cannot be prestored, there being indefinitely many of them), the language processor adopts the first analysis available. When multiple analyses of an input are precomputed (i.e. stored in memory), the language processor may consider various alternatives, as in the case of semantically ambiguous lexical items, syntactic category ambiguities, and lexical (thematic) frame ambiguities.* (op. cit.,p.521).

The difference between the simple past tense of a verb and the participle form of a verb is not a difference that cannot be prestored, so that one would expect that the language processor consider the various alternatives, rather than go for Minimal Attachment. Hence,

as it stands, their proposal of the delay strategy actually undermines the Minimal Attachment strategy explanation that they have proposed for dealing with 'garden-path' sentences like *The horse raced past the barn fell.*

Some evidence that the delay strategy is not used in the case of categorially ambiguous phrases comes from Marslen-Wilson & Tyler (1987). Marslen-Wilson & Tyler discuss a number of experiments they conducted to test their claim that semantics and context guide syntactic parsing (the strong interactionist view). They looked at ambiguous phrases, such as *landing planes*, which can have two different readings, an 'adjectival' and a 'gerund' reading. These phrases were put in disambiguating contexts, like the following:

2.21a. Adjectival bias

If you walk too near a runway, landing planes ...

b. Gerund bias

If you've been trained as a pilot, landing planes ...

These materials were presented through head phones, while at the acoustic offset of *planes*, etc., either IS or ARE was flashed up on a screen. The subjects had to name this word as quickly as possible.

Marslen-Wilson & Tyler found that reaction times were significantly faster for appropriate continuations of both the verbal and adjectival readings, than for inappropriate continuations. On the view that the delay strategy is used, we would expect no difference in reaction times for the different continuations, because on that strategy no analysis of the ambiguous phrase would have been made yet. Marslen-Wilson & Tyler also found that the effects of context were just as strong for these ambiguous phrases as they were for a comparison group of unambiguous phrases, such as *smiling faces*. Marslen-Wilson and Tyler argue that these findings show that context has a significant and immediate effect at the earliest point at which it can be measured.

However, Carston (1989) points out that when we look at the -ing words used in the unambiguous phrases, most of the examples used have transitive verbs as their base:

2.22a. Verbal

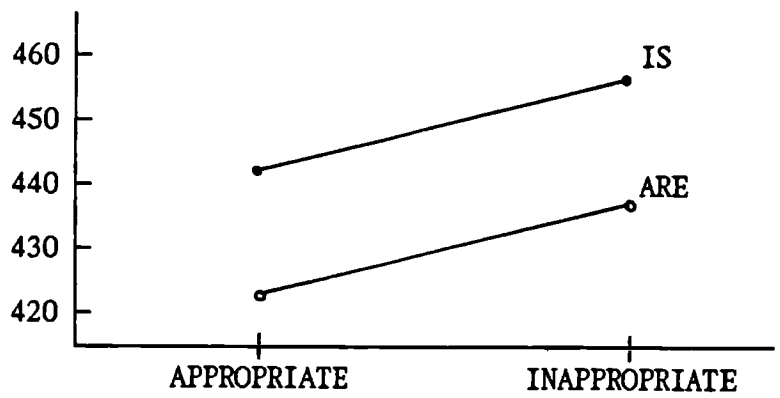
making movies, mixing drinks, cleaning teeth, whistling tunes, firing employees, turning corners, carving meat, shouting insults.

b. Adjectival

creaking stairs, working mothers, travelling salesmen, flattering remarks, shooting stars, wading pools, dancing classes, landing lights.

Carston says that this means that all the -ing words by themselves could be taken as either gerunds or adjectives, and because most of the verbs involved can take objects, also the whole phrase has two possible analyses. Carston argues that this suggests that all the phrases presented as unambiguous are in fact categorially ambiguous. It then seems that it is the semantic content of the whole phrase which determines whether the -ing word will be interpreted as an adjective or a gerund. For example, *cleaning teeth* does not seem very plausible on a 'teeth that clean' reading but it is not a structural impossibility, and might be quite plausible in some contexts, e.g. in a science fiction story. This then suggests that the processor accesses and processes the different possible analyses, rather than just accessing one, as Marslen-Wilson & Tyler assume. Disambiguation then takes place when semantics and context choose between these different analyses. However, Carston goes on to say that this is not the only possible explanation of the processing of these structures. An alternative is that the parser follows the Minimal Attachment strategy. According to Carston, on this strategy the parser would always try the adjectival analysis first, *"since a verbal analysis would require more nodes, presumably at least an additional S-node and an empty category NP subject."* (Op. cit., p.348). If this analysis is rejected on grounds of sense and plausibility, the parser will have to reanalyze the fragment. As evidence for the Minimal Attachment strategy, Carston points at the results obtained by Marslen-Wilson and Young (1984), from a rerun of the syntactic ambiguity experiment:

Mean naming latencies (in msecs) for appropriate and inappropriate IS and ARE targets:



Carston says about this:

> *"We see here the significant effect of contextual appropriateness on response times to the IS and ARE probes, a difference of around 20 msecs. in each case, but what is curious is that the two lines don't coincide. (...) Serial access of syntactic structures in accordance with some preferential strategy such as the Minimal Attachment Strategy would provide an explanation. If, when confronted with one of these -ing phrases, the parser goes for the adjectival reading, then given the plural noun in all the examples here, the continuation of ARE is, at this stage, more appropriate than IS. Only when the structure proves unable to integrate with the preceding context clause and so is rejected will the gerund structure be accessed. (...) This then looks like suggestive evidence for such a strategy, imposing serial access."* (op. cit., p.349).

However, an alternative explanation could be that on the gerund reading not only an additional S-node and an empty category NP subject have to be postulated, but also that a semantically/pragmatically appropriate filler has to be found for this empty subject. If this is the case, then we would expect the same kind of difference as Carston takes to be 'suggestive evidence' for the Minimal Attachment strategy.

It is interesting to compare the above to the third experiment that Frazier & Rayner (1987) conducted. This experiment was conducted to further test the generality of the delay strategy, and to distinguish more directly between the delay strategy and the semantic preference account (which predicts that the semantically preferred reading of an ambiguous string should take less time to read). The materials used contained similar ambiguous phrases to those tested by Marslen-Wilson & Tyler (above):

2.23a. Without a doubt, ringing bells is disturbing to everyone in the neighbourhood. (V-N ambiguous).

b. Without a doubt, ringing bells are disturbing to everyone in the neighbourhood. (A-N ambiguous).

c. Without a doubt, ringing loud bells is disturbing to everyone in the neighbourhood. (V-N disambiguated).

d. Without a doubt, loud ringing bells are disturbing to everyone in the neighbourhood. (A-N disambiguated).

Frazier & Rayner say that:

> *"in all sentences, the items immediately following the two target items [ringing bells] syntactically disambiguated the analysis of the target items. In the unambiguous versions (c and d forms), the position of the adjective (loud) or sometimes a determiner (some, the) disambiguated*

the target string before the second target item." (Frazier & Rayner, 1987, p.517).

It should be noted, though, that several of the type (d) sentences are in fact still ambiguous before the second target item, for example in (2.23d) *Without doubt, loud ringing ...* could be followed by *...of bells is disturbing to everyone in the neighbourhood.* Frazier & Rayner used 16 experimental sentences, which were tested in a prior rating study to establish what the preferred interpretation for the ambiguous fragments was (adjective–noun or verb–noun interpretation), by having 25 subjects complete the sentences from the second target item. Frazier & Rayner say that:

> *"If (counter to the delay strategy) the processor categorizes the first target item as soon as it is encountered, then the verb–noun form (a) should take less time to read than the adjective–noun form (b)."* (op.cit., p.517).

What we see here is that Frazier & Rayner predict that the 'first analysis strategy' would predict the opposite analysis to Carston's hypothesis that given the Minimal Attachment strategy the adjective–noun form should take less time to read. Unfortunately, Frazier & Rayner do not give an explanation of why the principle of Minimal Attachment would cause the processor to go for the verb–noun analysis.

Frazier & Rayner found that Minimal Attachment cannot account for their results, not on their prediction, nor on Carston's hypothesis:

Average Reading Time Per Character (in msecs.) for Ambiguous Words and for the Remainder of the Sentence in Experiment 3

	Syntactic class	Word order 1st	2nd	Remainder
Verb–noun preference				
Ambiguous	VN	35(245)	41(267)	40.5
	AN	33(240)	40(260)	43
Disambiguated	VN	43(295)	45(292)	35
	AN	39(277)	49(314)	41.5
Adjective–noun preference				
Ambiguous	VN	32(235)	40(259)	44.5
	AN	36(248)	40(262)	39.5
Disambiguated	VN	38(266)	44(285)	37.5
	AN	40(288)	45(293)	34

Although the 'unpreferred' VN sentences took slightly longer to disambiguate than the 'unpreferred' AN sentences, and the 'preferred' VN sentences took slightly longer to disambiguate than the 'preferred' AN sentences, the 'preferred' ambiguous AN sentences took significantly longer in the disambiguating area than the 'preferred' disambiguated AN sentences. The 'unpreferred' but already disambiguated AN sentences

also took slightly longer in the 'remainder' area than the 'preferred' ambiguous VN sentences. Neither of these findings can be explained with the Minimal Attachment strategy. On the view that the Minimal Attachment strategy predicts that the verb-noun analysis is made, there should not be any difference in reading times in the disambiguating area of the ambiguous and disambiguated V-N sentences, which there is. Moreover, reading times for the A-N sentences should be longer than for the V-N sentences, regardless of preferences, which they are not. On the view that the Minimal Attachment strategy predicts that the adjective-noun analysis is made, there should not be any difference in reading times in the disambiguating area of the ambiguous and disambiguated A-N sentences, which there is. Moreover, reading times for the V-N sentences should be longer than for the A-N sentences, regardless of preferences, which they are not. It seems then that contrary to Carston's claim, Marslen-Wilson & Tyler's results discussed above cannot be explained by postulating the Minimal Attachment strategy.

Altmann & Steedman (1988) report on some experiments they conducted in order to investigate the effects of referential context on locally ambiguous prepostional phrases, i.e. PPs that are locally ambiguous between NP attachment and VP attachment as in:

2.24a. The burglar blew open the safe *with the diamonds.*

b. The burglar blew open the safe *with the dynamite.*

The experiments tested the hypothesis that the NP attachment is facilitated when the preceding context introduces more than one candidate referent to the NP. The VP attachment should be facilitated when there is just one candidate referent to the NP in the preceding context. Altmann & Steedman contrast this hypothesis with predictions made by Minimal Attachment:

> "*Under the minimal attachment hypothesis, one would expect no effect of context on the VP-attached materials, since these are minimally attached and hence the first analysis to be chosen will be the correct one. Moreover there should be no effect of referential context on the NP-attached targets because the VP attachment will always be attempted first, and then be rejected on the basis of Rayner's et al.'s (1983) thematic selection process, in which real world knowledge, (...), coupled with knowledge about the alternative thematic structures of a verb (e.g., <experiencer, theme> versus <experiencer, theme, instrument>), is used to suggest an alternative attachment.*" (Altmann & Steedman, 1988, p.218).

In the first experiment global reading times were measured. Altmann & Steedman briefly discuss this method of testing as compared to eye-movement measurements:

> *"Although eye-movement data have been argued to provide a finer-grain analysis of where reading time differences are located, we feel that reading times alone are only marginally less informative. It is often unclear what differences in eye movements reflect."* (op. cit., p.217).

They used materials like the following:

2.25. NP-supporting context:

A burglar broke into a bank carrying some dynamite.
He planned to blow open a safe.
Once inside he saw that there was a safe with a new lock and a safe with an old lock. (2 referents)

VP-supporting context:

A burglar broke into a bank carrying some dynamite.
He planned to blow open a safe.
Once inside he saw that there was a safe with a new lock and a strongbox with an old lock. (1 referent)

NP-attached target sentence:

The burglar blew open the safe with the new lock and made off with the loot.

VP-attached target sentence:

The burglar blew up the safe with the dynamite and made off with the loot.

Furthermore, two additional contexts were created, by replacing the first sentence of each of the contexts above by:

2.26. A burglar broke into a bank carrying some dynamite and some gelignite.

In these additional contexts there are two instruments rather than one. Altmann & Steedman say that these contexts may make the VP attachment more felicitous, because there is a choice of instrument.

Altmann & Steedman found that there were effects of referential context on the VP- and the NP-attachments, and also that the minimally attached VP materials evoked longer response times than the nonminimally NP-attached materials:

Experiment 1: Reading times per sentence (in centiseconds)

	Context			
	1 referent		2 referents	
Target	1 instrument	2 instrument	1 instrument	2 instrument
VP-attachment	275.2	275.5	310.9	313.4
NP-attachment	272.7	276.8	262.0	265.0

We see that the contexts involving two instruments did not in fact induce faster reading times for the VP-attachment sentences: the differences between the reading times for the 1 instrument and 2 instruments contexts are not significant in the 1 referent context nor in the 2 referents context. To counter the possible objection that these reading times do not reflect differences located at the disambiguating points, but reflect post-interpretive processing effects, Altmann & Steedman conducted a second experiment in which phrasal reading times were measured, rather than global reading times. In this experiment, the same context and target sentences were used, with the difference that, rather than having PPs in the contexts (such as 'with a new lock'), they had relative clauses, such as 'which had a new lock'. The target sentences were segmented as follows:

2.27. The burglar/blew open/the safe/with the dynamite (new lock)/ and made off/with the loot.

Altmann & Steedman obtained the following results in this second experiment:

Experiment 2: Reading times to Phrase 4 (in centiseconds)

	Context (no. of referents)	
Target	1	2
VP-attachment	66.9	71.5
NP-attachment	63.9	61.4

Altmann & Steedman say that these results reflect the results they obtained with the first experiment, so that they cannot be an artifact of differences occurring in the target sentence:

> *"... the global reading times from experiment 1 are reflected almost perfectly in the phrasal reading times found [in experiment 2] using one of the on-line-measures favoured by Ferreira and Clifton (1986) themselves. Given that the results so closely mirror those of Experiment 1, this experiment provides evidence against the suggestion that the pattern of results in the earlier experiment may have been artifactual on the fact that the contexts had contained prepositional phrases which, like the NP-attached target sentences, modified NPs, but had not contained any prepositional phrases, which, like the VP-attached target sentences, modified VPs."* (op. cit., p.226).

What we have seen is that the experimental findings cited in support of the Minimal Attachment strategy either do not support the use of this strategy, or are open to alternative explanations. As we have seen some of the 'evidence' depends on an intuitive use of the notion of 'pragmatic plausibility', while at the same time the researchers have not taken into account the pragmatic effects that the use of, for example, restrictive relative clauses may have. That Minimal Attachment seems to explain some of these findings turns out to be a consequence of the fact that a lot of experimental sentences are presented in isolation: often, the Minimal Attachment reading of an ambiguous sentence coincides with what Crain & Steedman (1985), and Altmann & Steedman (1988) call the reading carrying fewest presuppositions. When sentences are presented in a context, we see that subjects go for the interpretation which is contextually supported. Furthermore, we have seen that by proposing a 'delay strategy' in the case of categorially ambiguous phrases, adherents of the 'garden-path' model actually undermine their case for a principle of Minimal Attachment, because they do not give an explanation of why the processor would delay analyzing the input in the case of ambiguity between a noun interpretation and a verb interpretation, but not in the case of ambiguity between a simple past vs a participle form of a verb. Moreover, when we looked at the experimental findings concerning categorially ambiguous phrases, it turned out that the findings do not support either a delay strategy, nor a Minimal Attachment strategy. Instead the processor seems to compute multiple analyses until it obtains semantic/pragmatic information which enables it to disambiguate the phrase. And as we saw in chapter 1, this is what Relevance theory predicts in the case of ambiguity.

2.2. Late Closure.

The second principle proposed in the 'garden-path' model is the principle of Late Closure. This principle states that, " *if grammatically permissible, new nodes are attached into the clause or phrase currently being processed (i.e. the phrase or clause postulated most recently.*" (L. Frazier, 1987a, p.562). In this section, we will evaluate the experimental findings which are said to support Late Closure.

Frazier & Rayner (1982) report on an experiment they carried out in order to test the validity of postulating the Late Closure strategy. They recorded eye movements of subjects reading sentences like the

following, in which the length of the ambiguous phrase was varied (long-short):

2.28a. Since Jay always jogs *a mile and a half* this seems like a short distance to him. (Late closure-Long).

b. Since Jay always jogs *a mile and a half* seems like a short distance to him. (Early closure- Long).

c. Since Jay always jogs *a mile* this seems like a short distance to him. (Late closure-short).

d. Since Jay always jogs *a mile* seems like a short distance to him. (Early closure-short).

They found that the late closure sentences took significantly less time to read than the early closure sentences, as was predicted by the late closure strategy. However, when we look at the sentences used in this experiment, the question arises whether these sentences do not actually bias the reader towards one interpretation rather than the other. When a reader encounters sentences like the sentences in (2.28) in a normal piece of writing, the two clauses in both the late and early closure sentences will be separated by a comma, e.g.:

2.29a. Since Jay always jogs a mile, this seems like a short distance to him. (Late closure).

b. Since Jay always jogs, a mile seems like a short distance to him. (Early closure).

Leech & Svartvik (1975) note about this that:

> *"In written English, a PIECE OF INFORMATION can be defined as a piece of language which is separated from what goes before and from what follows by punctuation marks (. , ; : - ? !), and which does not itself contain any punctuation marks.* (Leech & Svartvik, 1975, p.170).

When the subjects in the experiment encounter *a mile* without a comma separating it from *jogs*, they will take it to be part of the same 'piece of information', so that there is no need for them to postulate that it is the beginning of a new clause. When the subjects encounter *this* without a comma separating it from *mile*, they are forced to take it as the beginning of a new clause, because it cannot be incorporated in the existing clause. This means that leaving out the commas in these sentences actually biases the reader towards the Late Closure reading of the sentences, so that the findings seem to tell us more about the role of commas in written language than about whether the Late Closure strategy is used.

Kennedy & Murray (1984) report on an experiment they conducted using similar materials to those of Frazier & Rayner (the sentences in (2.28)). They were primarily interested in whether patterns of word-by-word reading times vary for the same materials depending on whether these materials were presented in a cumulative mode (in which words previously read remain visible), whether all words were visible at once, or whether words previously read were unavailable for inspection. Their findings with regards to the Late Closure strategy confirm the results of Frazier & Rayner (1982). However, since they also presented their materials with omission of commas, the same point regarding the validity of their findings as evidence for the Late Closure strategy that was made above can be made here.

Mitchell & Holmes (1985) conducted several experiments to test the suggestion that the verb of a sentence contributes critical information that might be used to guide the parsing of a potentially ambiguous clause or phrase. They used materials containing different types of structural ambiguity, among others preposed clauses that could give rise to early or late closure:

2.30. As soon as he had (arrived/phoned) his wife ....

Before conducting the experiments, Mitchell & Holmes collected subjects' preferences for readings of the structurally ambiguous sentences in view of the different verbs used (such as *arrived* vs. *phoned*), using a questionnaire technique similar to that used by Ford et al. (1982). It was found that changing the verb shifted the structural choice in the expected direction, i.e., with a transitive verb like *phoned*, the preferred reading was:

2.31. As soon as he had phoned his wife, (something else happened).

whereas with an intransitive verb like *arrived*, the preferred reading was:

2.32. As soon as he arrived, his wife (did something).

In the first experiment the sentences were presented in segments, in a subject-paced reading task, e.g.:

2.33. As soon as he had/ (arrived-phoned) his wife/ *started to prepare/* for the trip.
(the italicized segment is the 'Indicator segment').

Mitchell & Holmes found that the Indicator segments took different times to process depending on whether the sentence supported the

preferred reading of the verb involved or not, so that the Indicator segments were processed significantly faster when following an intransitive verb (the 'Non-Garden Path condition'), than when following a transitive verb (the 'Garden Path condition'):

Mean Viewing Times for Indicator Displays (in msecs.).

	Non-Garden Path Condition	Garden Path Condition
Early vs. late closure (Mitchell & Holmes, 1985, p. 549).	1230	1434

In the second experiment, Mitchell & Holmes (1985) used the same materials as were used in experiment 1, but here they presented the test sentences as a whole. This was done to counter the possible objection that the 'garden-path' effects could have been merely an artifact introduced by the use of segmented materials.

They found that although reading times in this experiment were rather longer than in the previous one, they found that the 'garden-path' effect was significantly similar to the effect found in the first experiment:

Mean Viewing Times for Entire Test Sentences (in msecs.)

	Non-Garden Path Condition	Garden Path Condition
Early vs. late closure (op. cit., p. 551).	5739	7485

If the parser operates solely on the principles of Minimal Attachment and Late Closure, then it is inexplicable why both conditions (the 'Garden Path' and the 'Non-Garden Path' conditions) do not give rise to an initial Late Closure analysis (in which the second NP is analyzed as a 'sister' of the verb), which then has to be reanalyzed. These findings seem to indicate that subcategorization information about the verbs is used in parsing the sentences.

In the third experiment Mitchell & Holmes (1985) tested the structural interpretation of the garden path effect by using punctuation marks and other surface structure cues to disambiguate the sentences in favour of the interpretations required by the 'Indicator' segments. They did this in order to test the possibility that the effects found were due to the general implausibility of the meaning of the sentence, rather than to the structural choices made by the subjects in processing the sentence. They say about this that:

> "*If the original effect was entirely due to inappropriate parsing decisions with one of the verbs, then the effect should become less pronounced when new cues are added to guide the reader to the correct structural interpretation. On the other hand, if the garden path effect in experiment 1 was attributable to the fact that the Indicator phrase was less plausible in one of the conditions (even on trials when the structural interpretation was correct), then the introduction of helpful surface structure cues should not reduce its magnitude. If anything, it should increase the probability of selecting the structural interpretation that generates the implausible combination of propositions, and so on this account the garden-path effect might even be slightly increased.*" (op.cit., p.552).

In this experiment a comma was introduced after the main verb in the early/late closure sentences. Furthermore, the segmentation was changed so that the main verb appeared in the first segment, thereby separating it from the NP that was intended to be the subject of the main clause:

2.34. As soon as he had (arrived-phoned),/ his wife/ *started to prepare/* for the trip.

As in the first experiment, the sentences were again presented in a subject-paced reading task. Mitchell & Holmes found that reading times for the garden path condition were significantly reduced in this experiment as compared to experiment 1:

Mean Viewing Times for Indicator Displays (in msecs.)

	Non-Garden Path Condition	Garden Path Condition
Early vs. late closure (op. cit., p.553).	1279	1333
(Compare Experiment 1:	1230	1528)

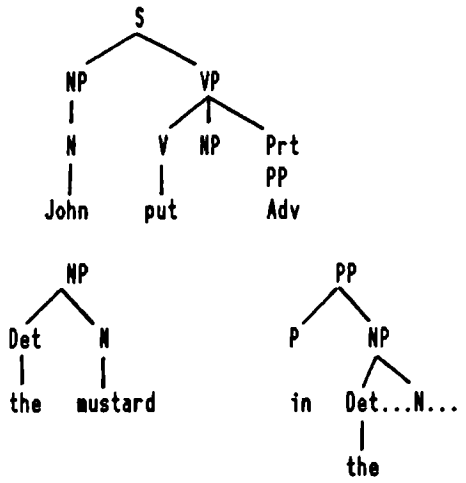
One can conclude from this that the major garden-path effects found in experiment 1 were produced by preferences regarding the argument structure of the verbs involved. For intransitives (which do not take an object) the only possible reading is the 'early closure' reading, and therefore they do not give rise to the 'garden-path' effect in any of the experiments. The preferred reading of transitives in these sentences is the reading with an explicit object, so that they give rise to the 'garden-path' effect, unless there is a marker (i.e. a comma) which rules out this reading. This means that subcategorization information of the verbs is used in processing these sentences.

These findings do not support postulating the Late Closure strategy. If we assume that parsing is solely guided by Minimal Attachment and Late Closure, then we would expect that the subjects in experiment 1 would not only be 'garden-pathed' in the sentences containing transitive verbs, but also in the sentences containing intransitive verbs, because (VP - > V NP) is a grammatically permitted expansion. This means that on the Late Closure view one would have to postulate that the parser also makes use of subcategorization information, which overrides the preferences given by the Late Closure principle. However, we would predict exactly the same results for these experiments if we postulate that the parser is guided only by subcategorization information.

Subcategorization information is not mentioned explicitly in the Minimal Attachment/Late Closure literature. It is alluded to in Frazier and Fodor (1978), when they discuss the example in (2.35):

2.35. John put the mustard in the ...

Frazier & Fodor say that a processor using the rules of grammar could establish with certainty the following partial phrase marker for this sentence fragment:



They point out that the processor knows that linguistic input must contain another noun as daughter to the NP within the PP, but it does not know how many other words will precede this noun. The processor also knows that the verb phrase must contain an NP and some sort of locative phrase, but it does not know whether *the mustard* and *in the ...* are the NP and the locative phrase that it is looking for. It seems then that Frazier & Fodor take it for granted that the processor makes use of subcategorization information, otherwise they would not

postulate that the above phrase marker could be built on encountering *put*.

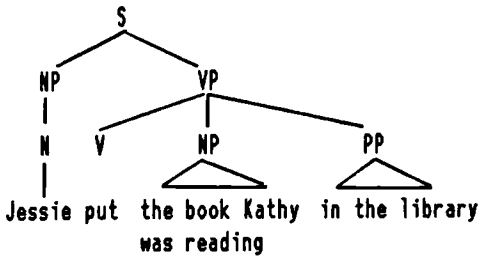
This does not shed any light on how the principle of Late Closure and subcategorization information interact. As we saw, in order to account for Mitchell & Holmes's (1985) findings we have to assume that subcategorization information overrides the preferences given by Late Closure. However, Frazier (1987a) says that Late Closure operates to choose low attachment of the PP in (2.36), overriding the available subcategorization information:

2.36. Jessie put the book Kathy was reading <u>in the library</u> ...

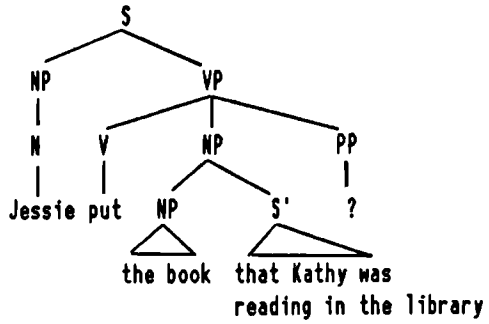
Frazier says about this example that:

> *"<u>Intuitions</u> indicate the prepositional phrase in [2.36] is initially interpreted as a sister to "read" despite the fact that "read" does not require a locative phrase but "put" does."* (Frazier, 1987a, p.568). (emphasis, mg.).

Frazier does not say whose intuitions indicate this. She implies that evidence for this analysis is to be found in Frazier & Fodor (1978) but this is not the case. However, even if it turns out that the Late Closure reading is the preferred reading of (2.36), this example is not without problems. If the parser makes use of subcategorization information , as is implied by Frazier & Fodor, then it is not clear why the parser would interpret the PP as a sister of *read*, rather than of *put*, especially since *read* does not require a locative phrase, whereas *put* does. Moreover, if subcategorization is used, then there is a clash between the Minimal Attachment and Late Closure strategies: on the Minimal Attachment strategy, the PP in (2.36) would be attached to the VP in the main clause:



By attaching the PP to the VP in the subordinate clause the parser creates a (potentially) unnecessary node, since the main clause must still contain some sort of locative phrase:



It seems that, if subcategorization information is used by the parser, the Late Closure strategy has precedence over the Minimal Attachment strategy in this example. Why else would the parser prefer a syntactically incomplete string to a complete sentence? But if this is the case, it is not clear why Minimal Attachment seems to have precedence over Late Closure in many of the examples discussed in the last section, e.g.,

2.1. John hit the man with the stick.
  a. John (hit (the man)(with the stick)). Minimal Attachment.
  b. John (hit (the man with the stick)). Late Closure.

In order to account for example (2.36) we have to assume then that the parser solely operates on the principles of Minimal Attachment and Late Closure, without making use of subcategorization information. However, this clashes with the findings of Mitchell and Holmes discussed above.

Warner & Glass (1987) report on three experiments they conducted to determine the effects of various types of syntactic and nonsyntactic information on grammaticality judgments for 'garden-path' sentences with Late and Early closure readings. They presented short and long sentences like the following:

2.37a. When the boys strike the dog kills. (short intransitive).
  b. Before the boy kills the man the dog bites strikes. (long intransitive).
  c. After the dog bites the man the cat kills. (Short transitive).
  d. When the horse kicks the boy the dog bites the man. (Long transitive).

These sentences were presented in a variety of contexts. Some of these contexts were thought to be biasing towards the required interpretation, for example, by having the same syntactic structure, or by being semantically biasing. Others were thought to be biasing towards a 'garden-path' reading, by presenting an intransitive target

sentence in the context of a transitive sentence, or by semantically biasing towards the garden-path reading. For example the short intransitive garden path sentence (2.37a) above was presented in the following contexts:

2.38a. Contexts biasing towards the grammatical interpretation:

Syntactic:

Before the man sleeps the cat eats.

(this sentence has the same (intransitive) structure as the target sentence).

Semantic:

The dog becomes dangerous while the boys attack.

b. Contexts biasing towards the ungrammatical interpretation:

Syntactic:

If the girls pet the cat they sing.

(a transitive context sentence followed by an intransitive target sentence).

Semantic:

Violence occurs because the boys attack the dog.

c. Control (Neutral context):

Men have to be put out.

In the first experiment the materials were presented one word at a time without punctuation using the rapid visual presentation method. At the end of each sentence subjects had to make a grammaticality judgment. Subjects were instructed to respond as quickly as possible, without taking time thinking further about the materials. The purpose of using a rapid, on-line form of presentation was to make the syntactic judgments as free as possible of conceptual processes.

Warner & Glass found that context significantly affected the proportion of 'garden-path' sentences called grammatical. When the context biased towards the grammatical interpretation this would increase the likelihood of the sentence being called grammatical, and when the context biased towards the ungrammatical interpretation this would increase the likelihood of the sentence being called ungrammatical. They also found that there was a 'powerful' preference for a transitive construction. In four out of five of the different context conditions, intransitive sentences were more likely to be misinterpreted as being transitive than the reverse. This is not

surprising if we accept that the absence of punctuation in fact biases towards a transitive reading of the materials.

It may be argued that, because the grammaticality judgments were made at the end of each sentence, they reflect conceptual processes rather than structural analyses, and therefore cannot give us an insight into whether the Late Closure strategy was used or not. However, it turns out that the findings are problematic for the view that the Late Closure strategy is used, even taking into account that conceptual processes have taken place. When we look at, for example, the syntactic context conditions, we see that with the short and long transitives, 100% were judged grammatical in the positive context, but only 56% of the short and 61% of the long transitives were judged grammatical in the negative context, e.g.

2.39a. Negative syntactic context:

While the boy swims the dog that the man owns plays.

b. Target sentence:

After the cow kicks the girl the horse bites.

Late Closure would assign the right structure to these target sentences; moreover, neither the semantics of the context sentence nor that of the target sentence is such as to bias towards the intransitive interpretation of the target sentence. Therefore, on the view that the Late Closure strategy was used, we would not expect subjects to judge these sentences ungrammatical, but they regularly did, as noted above. A possible objection here would be that the context and target sentences were semantically so dissimilar as to render the target sentence incomprehensible. However, when we compare these sentences to the sentence pairs consisting of a positive syntactic context sentence and a transitive target sentence, we see that these were as semantically dissimilar, e.g.:

2.40a. Positive syntactic context:

While the man completes his work the clock chimes.

b. Transitive target sentence:

After the horse kicks the boy the dog bites.

These target sentences were always judged grammatical. This then implies that the structure of the context sentence influences the way in which structure is assigned to the target sentence. But this is not compatible with the view that parsing is guided solely by the principles of Minimal Attachment and Late Closure.

Frazier (1987a) says that she expects Late Closure to be a universal strategy, because if one assumes that the need to structure material quickly is related to restrictions on human immediate memory capacity, one may expect all humans to adopt the first available constituent structure analysis, which, according to her, is provided by the Minimal Closure and Late Closure strategies. Cuetos & Mitchell (1988) conducted a number of experiments in order to find out whether Late Closure is used in Spanish, which would add some evidence in favour of Frazier's expectation that Late Closure is universal. In the first experiment they presented Spanish subjects with sentences containing a relative clause, such as:

2.41. El periodista entrevisto a la hija del coronel que tuvo el accidente.
(The journalist interviewed the daughter of the colonel who had the accident.)

The subjects were presented with a sentence followed by a question for which they wrote down the answer. For example, the question following (2.41) was 'Who had had the accident?' (in Spanish). Late Closure predicts that the relative clause in these sentences is attached to the lowest NP (*del coronel* in (2.41)). However, Cuetos & Mitchell found that there was a marked tendency for Spanish subjects to follow an Early Closure strategy, and attach the relative clause to the second NP in the sentence (*la hija* in (2.41)). They conducted the same experiment with English subjects, using as far as possible literal translations of the Spanish test sentences. They found that English subjects favoured the Late Closure reading over the Early Closure reading, so that it seems that there is a genuine cross-linguistic difference in the way that Spanish and English subjects process these sentences.

Cuetos & Mitchell conducted a further three experiments, using a clause-by-clause subject-paced reading task, to test whether the Spanish subjects' preference for the Early Closure reading of the sentences in the first experiment reflected on-line choices, or whether the Spanish subjects initially used Late Closure, and then reversed the majority of their decisions before answering the questions. They used materials like the following:

2.42. Pedro miraba el libro de la chica/ que estaba en el salon/ viendo la tele.
(Peter was looking at the book of the girl/ who-that was in the living room/ watching TV.)

2.43. Alguien disparo contra el criado de la actriz/ que estaba en al balcon/ con su marido.
(Someone shot the (male) servant of the actress/ who was on the balcony/ with her husband.)

If an Early Closure strategy is adopted for these sentences, and the relative clause is attached to, for example *libro* in (2.42), then the reader should have some difficulty in interpreting the final clause, because books do not watch TV. Cuetos & Mitchell found that the results of their experiments indeed pointed to the use of an Early rather than a Late Closure strategy. However, as they point out:

> *"(...) after we had completed the experiments it occurred to us that we had inadvertently relied on the use of the Late Closure strategy in designing the materials for the on-line studies. The underlying rationale of these experiments was that the final phrase or clause of each sentence (e.g., "watching TV" in example [2.42]) should have been easy to process if subjects had used the Late Closure strategy to handle the preceding (ambiguous) display but difficult to process if they had not. However, it is clear that this prediction only follows if the final display is itself attached to the material in the second display (i.e. using Late Closure). If the relative clause had been closed early, forcing the final display to be attached at some higher point in the sentence (e.g., to the word "girl" in example [2.42]), then there would not necessarily have been any processing difficulty in this condition. In other words, the results suggest that while Early Closure was apparently used for the possessive construction, Late Closure must have been used in attaching the final adverbial clause to the relative clause. This raises questions about the prevalence of Early and Late Closure strategies in Spanish."* (Cuetos & Mitchell, 1988, pp.92-93).

One of the questions Cuetos & Mitchell address is why the 'general rule' of Late Closure is overruled in some of the constructions used in the experiments. They tentatively conclude that Early Closure may be used by Spanish speakers in possessive constructions because in Spanish, unlike in English, adjectives follow the noun, rather than precede it. Because of this the sequence (...N-adj-RC...) is quite common in Spanish. This might give rise to a generalized strategy of the form (...N-[modifying constituent]-RC...) which would cause the addressee to attach the relative clause to the first N when this

constituent contains a noun phrase. This specialized strategy then takes precedence over the more general Late Closure strategy which will be used when this specific configuration is not encountered.

However, one can ask whether one can justifiably claim that if the relative clause had been closed early there would not necessarily have been any processing difficulty, because the final display would have been attached higher up in the tree. Although it may be the case that attaching the final display at some higher point does not present processing difficulties from the point of view of syntactic processing, it does imply a shift of focus and perspective:

2.44. Peter was looking at ((the book (of the girl))(that was in the living-room)) (*the girl was*) watching TV.

MacWhinney (1977) found that perspective maintenance or change influences the ease of processing for languages like English and German, and MacWhinney & Pleh (1988) found the same in a study of the processing of restrictive relative clauses in Hungarian. They found that sentences with relative clauses were processed easiest (leading to lowest error rates) when the subject of the main clause was also the subject of the relative clause, more difficult when the object of the main clause was the subject or the object of the relative clause, and most difficult when the subject of the main clause was the object of the relative clause. This pattern of results is the same as that found in English, French and German.

When we look at the analysis in (2.44) we see that the subject of 'watching tv' is not the subject or object of the main clause, but rather the NP within the PP modifying *the book* (i.e. the PP which helps determine which book is meant). This means that the perspective is changed even more dramatically than in the difficult SO pattern. If this is the case, then we would expect processing difficulties to occur on an Early Closure as well as a Late Closure reading of sentences like (2.44). The findings of Cuetos & Mitchell then do not provide any evidence for the use of the Late Closure strategy in Spanish, whereas they do show that there are cases where it is not followed, i.e. the possessive constructions.

Most studies set up to test the Late Closure strategy involve written materials, which often give rise to unnatural constructions, i.e. two clause sentences in which the clauses are not separated by a comma. Carroll & Slowiaczek (1987) report on some experiments they conducted to test the influence of prosodic structure on language

processing. In one experiment they used Early Closure /Late Closure sentences like the following:

2.45a. Early Closure

[Because her grandmother knitted][pullovers][kept Cathy warm in the wintertime].

b. Late Closure

[Because her grandmother knitted][pullovers][Cathy kept warm in the wintertime].

In the experiment an Early Closure and a Late Closure form of each of 40 sentences was spoken naturally and recorded. These sentences were then spliced as shown in (2.45). The segments of the two versions of the sentence were recombined to form eight conditions, involving a late (prosodic) boundary, an early boundary, both boundaries and no boundary, for both the Late and Early Closure sentences.

Carroll & Slowiaczek found that the prosodic information had an important impact on how quickly the sentences were understood:

> *"When the prosodic information was inconsistent with the syntactic information (i.e. in the late-closure/early-boundary condition or the early-closure/late-boundary condition), response time was slower than in the consistent conditions. In addition, the late-closure sentences were generally comprehended more rapidly than the early-closure sentences. This experiment shows that prosodic information can influence how a sentence is organized for comprehension."* (Carroll & Slowiaczek, 1987, p.225).

mean response times (in msecs.)

	Late boundary (knitted pullovers/)	Early boundary (knitted/ pullovers)	Both boundaries (knitted/ pullovers/)	No boundary (knitted pullovers)
Late Closure (Cathy kept)	1,132	1,536	1,142	1,243
Early Closure (kept Cathy)	1,798	1,282	1,537	1,386

(op.cit., p. 224).

The results in the Late and Early boundary conditions are as could be expected if one takes it that prosodic information applies before parsing. However, when we look at the other two conditions the results cannot be explained in such a straightforward way. In the 'both boundaries' condition we would expect the parser to go for the Early Closure reading after encountering the first boundary (as happens

in the 'early boundary' condition), and to reanalyze this to a Late Closure reading after encountering the second boundary. However, the reading times do not reflect this. The reading time for the Late Closure sentences turns out to be about as fast as in the 'late boundary' condition (1,132 vs. 1,142), where we would expect it to be slower. The reading time for the Early Closure sentences turns out to be faster than in the Late closure condition (1,798 vs. 1,537), where we would expect it to be slower, because on the assumption that the Late Closure strategy was used, we would expect this to involve two reanalyses (after encountering the second prosodic boundary and after hearing *kept*).

In the 'no boundary' condition, the Late Closure strategy would predict that the Late Closure analysis would be made in a straightforward way (because there is no prosodic information which would indicate otherwise), and we would expect the response times to reflect the times of the 'late boundary' condition. However, when we look at the response times, it turns out that the late closure reading takes slightly longer than in the 'late boundary' condition (1,243 vs. 1,132). On the other hand the Early Closure reading takes a lot less time than in the 'late boundary' condition (1,386 vs. 1,798). Although the slightly longer response time for the late closure reading might be explained by saying that this reflects the absence of confirmation of the analysis by a prosodic boundary, this does not explain why the early closure reading has a shorter response time. On the Late Closure strategy, reanalysis would have to take place in these sentences, and although there may not be confirmation of the Late Closure analysis, there is no confirmation of the Early Closure analysis either. These findings then do not constitute clear evidence for the use of the Late Closure strategy. Note that when one postulates that the parser makes use of the information that *knit* is a transitive verb which may or may not have its object filled by a lexical item, the findings in the last two conditions become far less problematic to explain: no reanalysis would have to take place.

2.3. Conclusions.

When reviewing the evidence for the Late Closure strategy, it turns out to be even weaker than the evidence for the Minimal Attachment strategy. Several of the experiments reviewed above rely on materials which in fact bias the reader towards the Late Closure reading, because of the absence of a comma. When a comma is introduced in the

materials (cf. Mitchell & Holmes, 1985) the effect disappears. In fact we have seen that these findings can be better accounted for if we postulate that the parser makes use of information about the argument structure of verbs.

As we have seen, the fact that Minimal Attachment and Late Closure seem successful in explaining some of the experimental findings is a consequence of the way in which experimental materials presented, i.e. in isolation. That this is the case is not surprising, if we accept that, all other things being equal, people go for the analysis involving least processing cost, which may well be an analysis which involves minimal attachment or late closure, since often such an analysis coincides with the reading for which one has to make fewest extra assumptions. However, as was shown in several of the experiments discussed above, when context is introduced, the preferred reading of a sentence turns out to be the reading that is supported by that context. In these cases, which resemble normal language use more than do experimental sentences presented in isolation, following a Minimal Attachment or Late Closure strategy regardless of context would be costly in terms of processing effort, since reanalysis would have to take place every time the Minimal Attachment or Late Closure analysis did not coincide with the contextually supported reading. What we have seen then is that the claim of Relevance theory that context plays an essential role in disambiguation and other operations is not ruled out by the experimental evidence, but is in fact supported by it.

Chapter 3: Verb subcategorization information.

In the literature on sentence comprehension, it is generally accepted that the processor makes use of verb subcategorization information (i.e. information about what kinds of arguments a verb can take[1]) at some stage in the process of interpretation. That we need verb subcategorization information in interpreting sentences can be illustrated by comparing the incomplete sentences in (3.1):

3.1a. While John greeted the man ...

b. While John hesitated the man ...

Whereas we interpret *the man* as being greeted by John in (3.1a), we cannot get the interpretation that *the man* is hesitated by John in (3.1b). Rather (3.1b) does not make sense unless we assume that *the man* is the beginning of the main clause, and not part of the subordinate clause. That we get these different interpretations for (3.1a) and (3.1b) can be explained by postulating that we recover the subcategorization frames of the different verbs, which tell us that *greet* takes two arguments, a subject and an object, whereas *hesitate* only takes one argument, a subject.

If we assume that verb subcategorization information is used by the processor then we have to ask how and when such information is used. In the literature there are a number of different proposals concerning this question (cf. Mitchell, 1989, for an overview). We can distinguish the different proposals along two lines. In terms of when verb subcategorization information is used, we can distinguish models which postulate that subcategorization information guides the processor in assigning structure to the input, and models which postulate that the processor first assigns a structure to the input using some different strategy, and then uses subcategorization information to check the consistency of the structure. Examples of serial checking models are Frazier (1987a,b,c), and Mitchell (1987, 1989), who assume that the processor assigns an initial structure according to the principles of Minimal Attachment and Late Closure, and that subcategorization information is used to check this initial structure.

Concerning the question of how verb subcategorization information is used, we can distinguish models where subcategorization frames are stored and accessed according to lexical preference, i.e. the processor initially goes for the most probable or frequently used subcategorization frame (serial), and models where all possible subcategorization frames of a verb are recovered (parallel). The best

known example of a serial guidance model is Ford, Bresnan & Kaplan's (1982) lexical preference model, which postulates that when the processor encounters a verb with multiple subcategorization frames, it will initially select the preferred one, and only access any other frame if it cannot assign a structure based on the preferred subcategorization frame. An example of a parallel guidance model is Fodor, Garrett & Bever's (1968) model, the lexical analysis strategy, in which it is postulated that, on encountering the verb, the parser retrieves all subcategorization frames of the verb and uses these to assign structure to the sentence. Models based on parallel access have been criticized in the literature, on the grounds that the predictions they make are not borne out. This type of model has been said to predict that there will be an increase in processing load following a complex verb (a verb with different subcategorization frames) as compared to the processing load following a simple verb. It has been argued that the experimental evidence does not support this prediction (e.g. Frazier & Rayner, 1982, 1987; Hakes, 1971; Mitchell, 1989; Mitchell & Green, 1978).

In this chapter, I will evaluate the evidence that has been presented in support of the different proposals. I will start by looking in more detail at the evidence for models in which it is assumed that subcategorization information becomes available serially, according to lexical preference, either for guiding the processor, or for checking the initial analysis.

Before we can establish which type of model reflects the way in which the processor uses this information, we have to look at what it means for subcategorization frames of verbs to be stored and accessed according to lexical preference. According to Ford et al. (1982),

> *"It seems perfectly reasonable to assume that lexical forms differ in their strength. It is well known that words themselves vary in their salience. There are many studies which show, for example, that words differ in their ease of recognition depending on their frequency of usage. It is thus plausible that lexical forms also vary in their strength. (...) It may be that strength is determined by the general frequency of usage in texts and speech in society and that there is an underlying stability in the human memory structure (...). But it could also be that the immediate context of a sentence might dynamically change the strength of lexical forms as a sentence is being processed."* (Ford et al., 1982, p. 745).

They put forward a number of different possibilities which make different predictions. In the first place, if the strength of

different frames is determined by the general frequency of usage in texts and speech in society, then we would expect that people in different communities would have different preferences. For example, we would expect that a test pilot would have the transitive frame of *fly* as the preferred frame (as in *I flew a DC10 yesterday*), whereas a business person who has to fly a lot would have the intransitive frame as the preferred frame (as in *I flew to Manchester last week*). This possibility would mean that any findings concerning lexical preferences would have to be relativized to the background of the subjects involved. I will call this the 'weak preference claim'. In the second place, if intra- or extra-sentential context can dynamically change the strength of lexical forms as a sentence is being processed, then we would need an account of how this process of changing the strength takes place. Only with such an account would we be able to distinguish between a 'neutral' preference and a contextually induced preference. It is only if there is an underlying stability in human memory structure concerning lexical preferences, independent of influences of different speech communities and of context, that we will be able to use specific findings concerning verb frame preferences as the basis of further experiments, regardless of the backgrounds of the subjects involved. I will call this the 'strong preference claim'.

3.1. Lexical preference.

Although there are many proponents of the view that verbs are stored and accessed according to their preferred readings, either in guiding the processor or in checking the initial structure, it is very difficult to find evidence which unequivocally supports this view. If we conduct experiments to establish if and when lexically preferred forms of the verb play a role in the interpretation process, then we need to know which subcategorization frame is actually the preferred one. Three sources are used for establishing which subcategorization frame of a verb is the preferred one: introspection, where authors rely on their own intuitions concerning preferred readings of verbs; conscious preference judgments, where subjects are asked to say which of two readings of a sentence they prefer, for example, a reading with the verb used transitively or a reading with the verb used intransitively; and sentence completion tasks, where subjects are, for example, given a noun phrase and verb, and are asked to complete the sentence. There are a number of problems with these tasks, which raise the question of how reliable they are in giving us an insight in

the way in which verb subcategorization information is actually stored and accessed.

3.1.1. Introspection.

That judgments concerning language processing based on introspection should be treated with extreme caution was shown, for example, in the experiments by Swinney (e.g. Swinney, 1979, 1982). As we saw in Chapter 1, Swinney tested the intuition that biasing contexts facilitate lexical decisions. He presented subjects with sentences like *I wanted to write a letter to my mother but I couldn't find a pen*, and then presented subjects with words about which they had to decide whether they were words or non-words. He found that decision times were faster for words related to the target word (i.e. *pen*), such as *ink*, than for words which were unrelated to the target word, such as *king*. However, *pen* is ambiguous between a reading as 'writing material' and 'animal enclosure', and Swinney found that words related to the reading of the target word which was not facilitated by the sentential context, such as *pig* were also recognized faster than the unrelated word. However, introspection led people to believe that only words related to the reading of the the target word facilitated by the context would evoke faster reaction times. Ford et al. (1982) refer to findings concerning word recognition to argue that it seems perfectly reasonable to assume that lexical forms of verbs vary in their salience (see quote above). However, on a par to that claim, we could take the Swinney results to indicate that all verb subcategorization frames are momentarily activated and that all but the contextually appropriate one are immediately discarded. One of the things that the Swinney experiments showed then, was that introspection can give us interesting intuitions, but empirical research may prove them wrong.

3.1.2. Conscious preference judgments.

Conscious preference judgments are in a sense another form of introspection, because again the experiment relies on subjects' intuitions. In these experiments, subjects are asked to say which interpretation of a sentence they prefer, for example, an interpretation with the transitive reading of the verb or an interpretation with the intransitive reading of the verb. Ford et al. (1982) tested people's intuitions about different sentences using the conscious preference judgment method. Twenty subjects were given a

booklet containing ambiguous sentences, and were asked to give their preferred interpretations. Of the sixty-seven sentences tested in this way, thirty-three sentences were concerned with verb-argument structure, testing sixteen different verbs, as illustrated in (3.2) and (3.3), with their possible interpretations in (3.2a,b) and (3.3a,b):

3.2. The woman wanted the dress on that rack.
  a. The woman wanted the dress which was on that rack. (90%)
  b. The woman wanted it (the dress) on that rack. (10%)

3.3. The woman positioned the dress on that rack.
  a. The woman positioned the dress which was on that rack. (30%)
  b. The woman positioned it (the dress) on that rack. (70%)

(The percentages at the end of the (a,b) sentences are the percentages of subjects preferring that interpretation.)

Ford et al. found that six of the thirty-three gave a result contrary to their expectations. For the remaining twenty-seven sentences they found that the preference in four sentences was a ratio of 45%-55%, in three sentences a ratio of 60%-40%, and in four a ratio of 65%-35%. The preference in the remaining sentences was a ratio of 70%-30% upwards, with two sentences having an absolute preference (100%-0%).

A problem with this sort of testing is that it is not clear what is actually tested. Although it could be the case that these results show the order in which verb subcategorization frames are stored and accessed, it could also be the case that the preferences shown for some readings over others is the result of the overall interpretation of the sentence. Clifton, Frazier & Connine (1984) discuss the examples in (3.2) and (3.3) of Ford et al., and say that:

> *"(...) the intuitions used as data in investigations such as this may be sensitive to very late stages of processing, and they seem likely to be sensitive to pragmatic information, including information about relations among the entities mentioned in the sentence (racks are things that dresses are positioned on)."* (Clifton et al., 1984, p. 697).

A different example is the following. Ford et al. gave subjects a sentence like (3.4):

4. Joe bought the book for Susan.

3.4a. Joe bought it (the book) for Susan.
  b. Joe bought the book which was for Susan.

They found that 80% of the subjects preferred the reading in (3.4a), whereas 20% of the subjects preferred the reading in (3.4b):

Ford et al. take this as showing that the preferred subcategorization frame of *buy* is the one with three arguments, as in (3.4a) rather than the one with two arguments, as in (3.4b). However, the result found for (3.4) is not necessarily evidence for lexical preference. An alternative explanation could be the following: to interpret (3.4) the subject has to make a number of assumptions, for example, the assumptions that Joe existed, that Joe bought something, that Joe bought a book. The word *bought* gives access to information about buying, for example, the information that when we buy something, we do that either for ourselves or for somebody else, which gives the interpretation in (3.4a). In order to get the interpretation in (3.4b) the subject has to make the extra assumption that it is relevant to know which particular book Joe bought, namely the one for Susan. However, because the sentence is read in isolation, there is no context which would encourage the subject to make this extra assumption, so that the interpretation involving least assumptions is (3.4a).

Ford et al. tested the verb *carry* in the sentence in (3.5), with the two interpretations in (3.5a) and (3.5b):

3.5. Joe carried the package for Susan.
  a. Joe carried the package which was for Susan. (10%)
  b. Joe carried it (the package) for Susan. (90%)

They interpret the result that 90% of subjects prefer the reading in (3.5b) to mean that the preferred subcategorization frame of *carry* is the one with three arguments.

However, they found that by putting a bit more context in the sentence they could affect the syntactic biases, as in (3.6) and (3.7):

3.6. When he arrived at our doorstep, I could see that Joe carried a package for Susan.
  a. Joe carried a package which was for Susan. (75%)
  b. Joe carried it (the package) for Susan. (25%)

3.7. Whenever she got tired, Joe carried a package for Susan.
  a. Joe carried a package which was for Susan. (5%)
  b. Joe carried it (the package) for Susan. (95%)

Ford et al. say that they are not concerned with the effects of context, but rather with how the contextually neutral preferences for alternative subcategorization frames govern closure. They use

ambiguous sentences for which they assume that the different readings are equally reasonable in meaning. They postulate that any variation in preference for these sentences must therefore arise from the strength of the preferences for the alternative subcategorization frames of the verbs involved. They use this argument to dismiss the finding that the lexical content of the grammatical arguments of a predicate can influence the bias, as in (3.8) and (3.9):

3.8. The Boy Scout carried the package for his pet.
  a. The Boy Scout carried the package which was for his pet. (75%).
  b. The Boy Scout carried it (the package) for his pet. (25%).

3.9. The Boy Scout carried the package for his aunt.
  a. The Boy Scout carried the package which was for his aunt. (10%).
  b. The Boy Scout carried it (the package) for his aunt. (90%).

However, this finding raises the question of whether one can be sure that a reported preference constitutes the preferred reading of a verb per se, or whether it constitutes a preferred reading induced by the other lexical material in the sentence.

Ford et al. use the argument of lexical bias to explain the result obtained for sentence (3.10), which was contrary to their expectations, even though both interpretations seem quite 'reasonable':

3.10. Her mother placed a $20 bill in the book for Mary.
  a. Her mother placed a $20 bill in the book which was for Mary.(35%)
  b. Her mother placed a $20 bill there (in the book) for Mary. (65%)

This result can be contrasted with the sentence in (3.11), which Ford et al. take to show the lexical preference for *place*:

3.11. The secretary placed the schedules in the packages for the participants.
  a. The secretary placed the schedules in the packages which were for the participants. (60%)
  b. The secretary placed the schedules there (in the packages) for the participants. (40%)

In order to account for the finding for (3.10), they say that:

> *"In sentence [3.10], the phrase her mother produces a bias against the interpretation our theory would predict subjects to favor. The use of the phrase her mother assumes that the reader knows who her refers to or that the information will be specified. In the interpretation we were expecting to be the preferred one, Mary cannot be taken as the person to which her refers, while in the other interpretation her can refer to Mary."* (op. cit., p.785).

However, in the same vein one can argue that the phrase *in the packages*, in which the definite article indicates that *the packages* are some particular packages, produces a bias against the interpretation of (3.11) as (3.11b), because it would be strange if the secretary placed schedules for the participants in packages which were not for those participants. It would be interesting to see what would be the preferred interpretation of (3.11) if the phrase *in the packages* was replaced by a phrase like *on the table* or *on the counter*, as in (3.11'):

3.11'. The secretary placed the schedules on the table/on the counter for the participants.

Ford et al. argue that the different results obtained for sentence (3.12), containing the verb *warn*, and sentence (3.13), containing the verb *debate*, is due to their different preferred lexical forms:

3.12. Those are the boys that the police warned about fighting.
  a. The police warned the boys about fighting. (89%) n=19
  b. The police warned about fighting the boys. (11%) n=19

3.13. Those are the boys the police debated about fighting.
  a. The police debated the boys about fighting. (45%)
  b. The police debated about fighting the boys. (55%)

The different interpretations of (3.12) and (3.13), Ford et al. argue, depends on where the subjects perceive a gap in the sentence, and this in turn is dependent on the preferred lexical form of the verb. For *warn* they assume this to be (subj), (obj), (about obj), and therefore they argue that a gap will be postulated after *warn*. For *debate*, on the other hand, they assume that the preferred form is (subj)(about obj), so that a gap will not be postulated after *debate*. However, this proposal does not explain why the findings for (3.13) are far less convincing than the findings for (3.12). For (3.13) the ratio is 45%-55%, i.e. 9 subjects versus 11 subjects, whereas for (3.12) the ratio is 89%-11%, i.e. 2 subjects versus 17 subjects.

A different explanation of the findings is possible which does not make use of the notion of lexical preference, and which can account for the difference in ratio in the findings for (3.12) and (3.13). When we look at (3.12), we see that there are two groups of individuals explicitly mentioned, *the boys* and *the police*. The preferred reading of (3.12), (3.12a), only involves those two groups of individuals, because we understand that the police warn the boys about fighting.

However, to get the interpretation in (3.12b) we have to construct a context containing a number of extra assumptions. For example, we would have to assume that there is another individual or several individuals involved, who have not been explicitly introduced into the context. We would also have to assume that these individuals have the intention of fighting the boys. Moreover, we would have to assume that the police knows about their intention to fight the boys, and do not want them to fight the boys, or believe that the boys are dangerous. We cannot interpret (3.12) as saying that the police warned themselves. In (3.13) we see that again there are two groups of individuals which are explicitly mentioned, *the boys* and *the police*. In the interpretation in (3.13a), which is like (3.12a), only these two groups of individuals are involved. However, in the interpretation in (3.13b) it is also the case that only these two groups of individuals are involved: we understand the interpretation in (3.13b) as expressing that the police were debating amongst themselves about fighting the boys. In other words we do not have to set up a context containing extra assumptions to get the interpretation in (3.13b), as we have to do in order to get the interpretation in (3.12b). Because both the (3.13a) and the (3.13b) interpretations are obtainable without one having to create an elaborate context, there is not much reason to prefer the one to the other, which is reflected in the almost equal numbers of subjects preferring one or the other interpretation (9 versus 11 subjects).

In the sentence in (3.14) the preferred reading is (3.14a) rather then (3.14b):

3.14. They signaled to everyone that they couldn't hear.
  a. They signaled to everyone the fact that they couldn't hear. (90%)
  b. They signaled to everyone who they couldn't hear. (10%)

Ford et al. take this to mean that the preferred lexical form of *signal* is the one in (3.14a) rather than the one in (3.14b). However, for the sentence in (3.15), which also involves the verb *signal* they found that there was no preferred lexical form:

3.15. They signaled to someone that they couldn't hear.
  a. They signaled to someone the fact that they couldn't hear. (50%)
  b. They signaled to someone who they couldn't hear. (50%)

Ford et al. argue that this result is due to the fact that the sentence in (3.15) is not well constructed: "*Neither interpretation of the sentence seems very sensible because of the vagueness of* someone."

(op. cit., p. 785). However, this argument is not very satisfactory, because one would expect that if lexical preference guides the processor in assigning a structure to a sentence, then the vagueness of a lexical item in a sentence should cause the lexical preference to show up even more strongly than in a sentence in which the content of the lexical items could influence the overall interpretation of the sentence more.

Ford et al. argue that the preferred lexical form of *object* in a sentence with a choice between a relative clause reading and a complement clause reading, as in (3.16) and (3.17), is the relative clause reading:

3.16. The tourists objected to the guide that they couldn't hear.
   a. The tourists objected to the guide who they couldn't hear. (55%)
   b. The tourists objected to the guide about the fact that they couldn't hear. (45%)

3.17. They objected to everyone that they couldn't hear.
   a. They objected to everyone who they couldn't hear. (55%)
   b. They objected to everyone about the fact that they couldn't hear. (45%)

However, when we look at the results we see that again (as was the case with (3.13)), these are not very compelling: for both (3.16) and (3.17) there is a ratio of 45%-55%, i.e. 9 subjects versus 11 subjects. Ford et al. do not give an explanation of why the lexical preference does not show up more strongly in these examples.

I propose that the explanation of these findings lies in the fact that not only can the verb *object* occur with different argument structures, but moreover, those different argument structures express different meanings of *object*, in other words, the verb *object* is ambiguous although the different senses are closely related. When we compare *object* to a verb like *carry* we see that whereas *carry* continues to express a meaning like *bear* or transport whether or not it occurs with a benefactive phrase like *for Susan*, as in (3.5), *object* either expresses that the subject feels disapproval towards the object, as in (3.16a) and (3.17a), or it expresses that the subject brings forward or states something in opposition to something, as in (3.16b) and (3.17b). That this is the case is borne out by the fact that the prepositional phrases in (3.16) and (3.17) have different thematic roles in the different interpretations: in the (a) interpretations the object of *to* is the theme, whereas in the (b) interpretations the object of *to* is

the goal and the subordinate clause is the theme. The sense of *object* as in the (b) sentences itself can occur with different subcategorization frames, i.e. both with a goal and a theme, or just with a theme as in (3.18):

3.18. They objected that the proposal would cost too much money.

This means that what Ford et al. are testing with the sentences in (3.16) and (3.17) is not which subcategorization frame of *object* is the preferred one, but rather which sense of *object* is the preferred one; and the result shows that there is no strong preference either way.

We can therefore conclude that the results obtained by Ford et al. do not constitute evidence for the claim that verbs are accessed according to lexical preference, either to guide the processor or to check the initial structure assigned by the processor to a sentence. Al of the results which seem to support lexical preference can also be explained in terms of the assumptions a reader has to make in order to get a full interpretation of the sentence. Results which do not support their proposal, or which show only a slight preference for one interpretation rather than the other, are not explained in a satisfactory way by Ford et al., but can in fact be explained without having to postulate that they are due to lexical preference.

Ford et al. argue that they are not concerned with context, but that they want to test how the 'contextually neutral strength' of different subcategorization frames influences the interpretation process. However, presenting a sentence in isolation does not mean that it is not processed in a context; the 'null context' is a context which has no assumptions in it. However, because the lexical items in the sentence give access to assumptions related to those lexical items, a richer context is built during the interpretation process, so that even when the addressee starts with the 'null context', it won't be empty anymore at the end of the interpretation process. The initial absence of assumptions may actually influence the interpretation process to a certain interpretation, not because it is 'contextually neutral', but rather because making extra assumptions will not yield a more plausible interpretation. Because the preference judgment is made after the sentence has been processed as a whole, this means that the sentence can never be 'contextually neutral', regardless of whether semantic and pragmatic information become available early or late in the interpretation process.

3.1.3. Sentence completion tasks.

Sentence completion tasks face a similar problem as conscious preference judgments. They are usually a form of 'gap-filling' task in which subjects are presented with incomplete sentences (for example, a noun phrase followed by a verb) and are asked to complete the sentence. If subjects tend to complete the sentence giving the transitive reading of the verb, then this is taken to be the preferred reading of that verb. But again, it can be objected that the lexical material present may influence the way in which a subject completes a sentence. For example, if we compare the incomplete sentences (3.19a) and (3.19b):

3.19a. The plant grows ....
3.19b. The gardener grows ....

it seems to me that (3.19a) invites a completion in which the intransitive reading of the verb is preferred, whereas (3.19b) invites a completion in which the transitive reading of the verb is preferred.

A different form of the sentence completion task is the norming procedure, which involves subjects making up sentences about certain topics using specified verbs. This method of testing subjects' preferences could be problematic since the choice of topic might influence the reading of the verb that the subjects prefer to use. For example, the verb *approve* can either be used with an object to express something like 'to agree officially to' (e.g. *The minister approved the plan*), or it can be used with *of* and an object to express something like 'to consider good' (e.g. *I don't approve of silly people*). It could be the case that the first reading would be used more often with a topic like 'news and current events', and the second reading would be used more often with a topic like 'clothes', or 'parties'.

Connine, Ferreira, Jones, Clifton & Frazier (1984) report on two experiments they conducted to establish verb frame preferences using the norming procedure. In the first experiment 39 subjects received a list of 46 verbs, and 39 subjects received a list of 45 different verbs, and both groups were asked to write a sentence for each verb, about some topic. Topics given included 'sports', 'schoolwork', 'news and current events', 'animals' and 'clothes'. In the second experiment 29 subjects received a list of 66 verbs, of which 30 had also been used in the first experiment, with a setting rather than a topic. These settings were 'home', 'downtown' and 'school'. Again

the subjects were asked to write a sentence for each verb. Connine et al. found that sentences were made up in nineteen different categories of syntactic structure, given below with example sentences:

1.	[ ]	The teacher remembered.
2.	[PP]	The teacher remembered in class.
3.	[inf-S]	The teacher remembered to talk.
4.	[inf-S]/PP/	The teacher remembered to talk in class.
5.	[Wh-S]	The teacher remembered who to punish.
6.	[that-S]	The teacher remembered that Tom flunked.
7.	[verb-ing]	The teacher escaped failing Tom.
8.	[perception compl.]	The teacher heard Tom leave.
9.	[NP]	The teacher remembered his books.
10.	[NP][NP]	The teacher gave Tom his books.
11.	[NP][PP]	The teacher gave his books to Tom.
12.	[NP][inf-S]	The teacher told Tom to study.
13.	[NP][Wh-S]	The teacher asked Tom what to teach.
14.	[NP][that-S]	The teacher told Tom that he should study.
15.	[adj. or N]	The teacher flew home.
16.	passive	The teacher was attacked.
17.	use verb as noun.	
18.	use verb as adjective.	
19.	other, unclassifiable.	

Connine et al. assume that the verb frame preferences of writers are similar to the preferences of readers and listeners, and that these preferences will decide what kind of sentence is made up. They report that their findings were such that the data can be used as a serviceable index of verb frame preference. However, this claim is based on their computing a measure of transitive bias by dividing the number of transitive completions (categories 9–14 above), by the number of transitive plus intransitive completions (intransitive categories 1–6 above). Although this measure shows differences in transitive bias for different verbs, it does not distinguish among the different possible subcategorization frames within the transitive categories, which play a crucial role in the proposal of Ford et al. (1982).

When we look at Connine et al.'s findings in detail, a more complex picture emerges. If verb frame preferences are the same for the different subjects, one would expect that high percentages of subjects would go for the same syntactic structure. However, the findings of Connine et al. do not unequivocally support this assumption. When we

look at the ninety-seven verbs that were used only once, either in experiment 1 or experiment 2, we see that only four verbs show a preference over 80% for one subcategorization frame: 92% of subjects gave a sentence with *try* [inf-S], 90% of subjects gave a sentence with *continue* [inf-S], 82% of subjects gave a sentence with *object* [PP], and 82% of subjects gave a sentence with *attempt* [inf-S]. For three verbs one frame was used by 70%-80% of subjects, for seven verbs one frame was used by 60%-70% of subjects, and for sixteen verbs one frame was used by 50%-60% of subjects. In other words, for thirty out of ninety-seven verbs, half or more of the subjects used the same lexical frame. On the other hand, for twenty-four out of ninety-seven verbs, the most used verb frame was only used by between 13% and 33% of subjects, while for a further fourteen verbs, the most used frame was used by just over one third of subjects, i.e. between 34% and 38%. Furthermore, for *motion*, the highest percentage of subjects using a frame was equal among three frames: 18% of subjects used [PP], 18% of subjects used [inf-S PP] and 18% of subjects used [NP inf-S]. For nine verbs, the highest percentage of subjects using a frame was equal between two frames. For seven verbs, the difference between the two most used frames was one subject; for thirteen verbs, the difference between the two most used frames was two subjects; for eight verbs the difference between the two most used frames was three subjects; and for five verbs the difference between the two most used frames was four subjects. In other words, for forty-three out of ninety-seven verbs, the difference between the two most used verb frames was between nil and four subjects. What we see then is that at the one hand almost a third of the verbs tested have a lexical frame which is preferred by at least half of the subjects, while on the other hand, over a third of the verbs tested have as the most used frame a frame which is preferred by between 13% and just over a third of subjects. Furthermore, we see that of the ninety-seven verbs tested we find that almost half of the verbs have two verb frames which are preferred by about equal numbers of subjects.

These findings then rule out the 'strong preference claim', at least for language production, since on that view, we would predict that high percentages of subjects would show preference for one frame for all verbs. It could be argued that these findings support the 'weak preference claim', the claim that the strength of different frames is determined by the different speech communities that the subjects belong to. On this view, it could be argued that different

lexical frames of different verbs are more or less specific to different speech communities, which would show up in more unified or more diversified uses of these different verbs. However, in both experiments all subjects were undergraduates of the University of Massachusetts, which implies that they at least share one important speech community. A possible alternative explanation of these findings could be that the use of different verb frames of some verbs is more constrained by the topic than of other verbs. Connine et al.'s findings for the thirty verbs which were used in both experiments might shed further light on this question. If the order of preference of lexical frames of different verbs is more or less sensitive to influences from specific speech communities, we would expect that verbs which show high percentages for one verb frame would show this preference in both experiments. On the other hand, if a high percentage for a specific lexical frame in the first experiment is due to the topic, or to some other factor, then it would not necessarily follow that this high percentage will be duplicated in the second experiment.

When we look at the thirty verbs which were used in both experiments, we find the following results. In both experiments together there were eleven verbs of which one lexical frame was used by more than half of the subjects. Comparing the results of the two experiments, we see that for three of these eleven verbs the most used frame differed in the two experiments, which does not support the view that lexical preference is used:

	1st experiment	2nd experiment
call	[NP] 54%	[Adj or N] 24%, [NP] 21%
paint	[NP PP] 46%, [NP] 26%	[NP] 59%
read	[NP] 62%	[NP PP] 38%, [NP] 21%

For the other eight verbs the same lexical frame was used most often, which could point at lexical preference being used. However, for these eight verbs the percentages of subjects choosing the verb frame in the two experiments differed between 1% and 32%:

	1st experiment	2nd experiment	difference
promise	[inf-S] 51%	[inf-S] 52%	1%
refuse	[inf-S] 95%	[inf-S] 97%	2%
leave	[NP] 54%	[NP] 48%	6%
visit	[NP] 56%	[NP] 48%	8%
watch	[NP] 60%	[NP] 48%	12%
buy	[NP] 49%	[NP] 66%	13%

clean	[NP]	56%	[NP]	31%	25%
beg	[PP]	60%	[PP]	28%	32%

Only for *refuse* is there an almost absolute preference for one lexical frame. Of the other seven verbs, only two show the same relative preferences for the two most used lexical frames:

buy	(1) [NP] 49%,	[NP PP] 15%,	[NP inf-S] 13%
	(2) [NP] 66%,	[NP PP] 21%,	[NP NP] 7%
visit	(1) [NP] 56%,	[NP PP] 36%,	[ ] - [PP] 3%
	(2) [NP] 48%,	[NP PP] 24%,	[Adj or N] 13%

whereas the other five verbs differ for the second and third frames with highest percentages:

beg	(1) [PP] 60%,	[NP inf-S] 28%,	[inf-S] - [NP PP] 5%
	(2) [PP] 28%,	[NP Wh-S] 21%,	[inf-S] 17%
clean	(1) [NP] 56%,	[NP PP] 21%,	[PP] 13%
	(2) [NP] 31%,	[PP] 13%,	[NP PP] 10%
leave	(1) [NP] 54%,	[NP inf-S] 13%,	[NP PP] 10%
	(2) [NP] 48%,	[Adj or N] 17%,	[Inf-S] - [NP PP] 7%
promise	(1) [inf-S] 51%,	[NP that-S] 26%,	[NP PP] - [that-S] 5%
	(2) [inf-S] 52%,	[that-S] 21%,	[NP that-S] 13%
watch	(1) [NP] 60%,	[perc comp] 13%,	[NP Wh-S] 10%
	(2) [NP] 48%,	[NP PP] 31%,	[PP] 10%

These findings cannot, therefore, be taken as conclusive evidence for lexical preference being used in language production.

When we look at the remaining nineteen verbs used in both experiments, again the findings do not unequivocally support the view that lexical preference is used: only one verb shows very similar results in the two experiments:

fight	(1) [PP] 38%,	[ ] 28%,	[NP] 8%
	(2) [PP] 28%,	[ ] 10%,	[NP] 7% - [Adj or N] 7%

A further six verbs have the same frame with highest percentage in both experiments, but differ for the second and third frames with highest percentages:

drive	(1) [PP] 44%,	[NP] - [NP PP] 21%	
	(2) [PP] 34%,	[Adj or N] 28%,	[NP PP] 13%
fly	(1) [PP] 49%,	[ ] 13%,	[NP PP] 8%
	(2) [PP] 45%,	[Adj or N] 38%,	[ ] 7%
hear	(1) [NP] 33%,	[that-S] 18%,	[PP] 15%
	(2) [NP] 41%,	[NP PP] 28%,	[that-S] 13%
hire	(1) [NP] 41%,	[NP inf-S] 23%,	[NP PP] 15%
	(2) [NP] 38%,	[NP PP] 28%,	passive 13%
race	(1) [PP] 49%,	[inf-S] 28%,	[ ] 8%
	(2) [PP] 31%,	[Adj or N] 21%,	[ ] 10%

sing	(1)	[PP] 33%,	[ ] 23%,	[NP PP] 21%
	(2)	[PP] 41%,	[NP PP] 21%,	[NP] 13%

Moreover, seven verbs got different results in the two experiments:

ask	(1)	[NP Wh-S] 26%,	[NP] 21%,	[PP] 18%
	(2)	[NP] 38%,	[NP PP] 28%,	[NP Wh-S] 13%
choose	(1)	[inf-S] 31%,	[NP] 26%,	[NP inf-S] 18%
	(2)	[NP] 38%	[PP] 34%,	[NP PP] 10%
debate	(1)	[PP] 33%,	[Wh-S] 26%,	[NP] 21%
	(2)	[Wh-S] 17%,	[PP] 10%,	[NP] - [NP PP] 3%
know	(1)	[Wh-S] 38%,	[that-S] 26%,	[Wh-S] - [NP PP] 17%
	(2)	[that-S] 28%,	[NP] 24%,	[NP PP] 10%
study	(1)	[NP] 33%,	[PP] 23%,	[ ] - [NP PP] 13%
	(2)	[PP] 48%,	[ ] 21%,	[inf-S]-[Wh-S]-[NP PP] 7%
teach	(1)	[NP] 49%,	[NP Wh-S] 15%,	[NP PP] 10%
	(2)	[NP PP] 28%,	[PP] 24%,	[NP] 13%
tell	(1)	[NP that-S] 28%,	[NP] 18%,	[NP Wh-S] 13%
	(2)	[NP Wh-S] 24%,	[NP]-[NP inf-S]	17%
help	(1)	[perc compl]-[NP	inf-S] 21%,	[NP]-[NP PP] 15%
	(2)	[NP PP] 24%,	[NP]-[NP inf-S]	13%

The last four verbs did not show strong differences between the different frames, but showed differences in percentages between nil and ten percent (3 subjects):

order	(1)	[NP] 31%,	[NP inf-S] 28%,	[NP PP] 18%
	(2)	[NP]-[NP PP] 28%,	[inf-S]-[NP inf-S] 3%	
play	(1)	[PP]-[NP PP] 36%,	[ ]-[NP] 10%	
	(2)	[PP] 34%,	[NP PP] 24%, [ ] 21%,	[NP] 17%
signal	(1)	[NP] 23%,	[PP]-[NP inf-S] 15%	
	(2)	[NP]-[NP inf-S] 13%,	[PP]-[NP PP] 7%	
write	(1)	[NP]-[NP PP] 28%,	[PP] 18%,	[ ] 13%
	(2)	[NP] 28%,	[NP PP] 24%,	[Adj or N] 17%

Connine et al.'s findings do not give us a clear indication that lexical preference is used in language production. Even their claim that the findings show a general transitive-intransitive bias is problematic in the face of verbs like *choose*, *study* and *play*, which give quite different biases in the different experiments:

choose	(1)	[inf-S] 31%,	[NP] 26%,	[NP inf-S] 18%
	(2)	[NP] 38%	[PP] 34%,	[NP PP] 10%
study	(1)	[NP] 33%,	[PP] 23%,	[ ] - [NP PP] 13%
	(2)	[PP] 48%,	[ ] 21%,	[inf-S]-[Wh-S]-[NP PP] 7%
play	(1)	[PP]-[NP PP] 36%,	[ ]-[NP] 10%	
	(2)	[PP] 34%,	[NP PP] 24%,	[ ] 21%, [NP] 17%

If lexical preference guides both language production and comprehension, then we would expect the findings of Connine et al. to emulate the findings of Ford et al. (1982). However, this is only the

case for a few verbs. Of the sixteen verbs tested on argument structure by Ford et al., eleven were also tested by Connine et al. When we compare the results we see the following:

Two verbs, *carry* and *debate* give rise to the same sort of results in the different experiments: for *carry*, Ford et al. found a strong preference (90%) for the [NP PP] frame over the [NP] frame (at least in one of their test sentences, see above). Connine et al. also found that more people used the [NP PP] frame then the [NP] frame (60%-30%). For *debate*, Ford et al. found a slight preference (55%) for the [PP] frame over the [NP PP] frame; this was also reflected in the Connine et al. results (33%-3%, and 10%-3%).

Four further verbs, *discuss, want, tell* and *position*, gave rise to strong preferences in Ford et al.'s experiments, which were not reflected in Connine et al.'s findings: for *discuss*, Ford et al. found a 100% preference for the [NP PP] frame over the [NP] frame. Connine et al., on the other hand, found that only 2 subjects preferred the [NP PP] frame over the [NP] frame (51%-46%). For *want*, Ford et al. found a very strong preference for the [NP] frame (90%) over the [NP PP] frame; Connine et al. found the same preference, but in greatly reduced form (28%-10%, i.e. 7 subjects). For *tell*, Ford et al. found a strong preference (90%) for the [NP that-S] frame over the [NP] frame. In the first experiment of Connine et al. this result was emulated, although in greatly reduced form (28%-13%). However, in the second experiment the [NP] frame was used more often than the [NP that-S] frame (17%-10%). For *position*, Ford et al. found a preference of 70% for the [NP PP] frame over the [NP] frame; Connine et al. only found that 3 subjects preferred the [NP PP] frame over the [NP] frame (36%-28%).

For *object* the pattern was reversed: while Ford et al. only found a slight preference for the [PP] frame over the [NP PP] frame (55%), Connine et al. found a strong preference for the [PP] frame over the [NP PP] frame (82%-3%).

The remaining four verbs, *keep, signal, buy*, and *include*, gave rise to quite different results in the different experiments: for *keep*, Ford et al. found a strong preference (95%) for the [NP PP] frame over the [NP] frame, but Connine et al. found a strong preference the other way around (46%-13%). For *signal*, Ford et al. found a strong preference (90%) for the [NP PP] frame over the [NP] frame; on the other hand, in both their experiments, Connine et al. found a slight preference for the [NP] frame over the [NP PP] frame (23%-10%, 13%-7%).

For *buy*, Ford et al. found a strong preference (80%) for the [NP PP] frame over the [NP] frame, while Connine et al. found a strong preference the other way around in both experiments (49%-15%, 66%-21%). For *include*, Ford et al. found a preference for the [NP] frame (65%) over the [NP PP] frame; Connine et al. found a slight preference for the [NP PP] frame over the [NP] frame (46%-41%).

If lexical preference is used at all, the preferences appear to vary depending on whether we are dealing with language production or comprehension. This in itself is not problematic for models with separate lexicons for production and comprehension. However, neither the Ford et al. findings, nor the Connine et al. findings present compelling evidence for the assumption that communicators use lexical preference at all.

3.1.4. Experiments based on sentence completion tasks.

Clifton, Frazier & Connine (1984) report on two experiments which they conducted to test whether lexical preference regarding transitive-intransitive use of verbs plays a role in sentence comprehension. In the first experiment subjects read 48 transitive and intransitive sentences containing transitive or intransitive bias verbs, as in (3.20):

3.20.	Verb preference	Sentence form	Sentence
a.	transitive	transitive	The babysitter read the @ story to the sick child.
b.	intransitive	transitive	The babysitter sang the @ story to the sick child.
c.	transitive	intransitive	The babysitter read to @ the sick child.
d.	intransitive	intransitive	The babysitter sang to @ the sick child.

The sentence presentation was interrupted at @ for a secondary task.

These sentences were presented visually one word at a time. A word or nonword irrelevant to the current sentence was presented directly following the first word after the verb, and subjects were asked to make a lexical decision about these words. Clifton et al. found that reaction times were significantly shorter or longer depending on whether the verb bias coincided with the sentence form or not:

Sentence form	Verb preference Preferred transitive	Preferred intransitive
Transitive	908	1008
Intransitive	1000	877

Mean reaction times in ms.

These findings seem to support the assumption that lexical preference guides the processor in assigning structure to the sentence. However, when we look at the materials used, there are a few problems. In order to determine which verbs have transitive or intransitive bias, Clifton et al. (1984) followed the norming procedure, along the lines of Connine et al. (1984) discussed above, apart from for a few verbs for which the experimenters' judgment was taken to be indicative of lexical preference. As we saw above, it is not clear that results obtained from the norming procedure can be taken as reflecting lexical preference, and besides, when the Connine et al. findings are compared with the Ford et al. (1982) findings, it seems that the uses or preferences shown are different for language production and comprehension. As was the case in the Connine et al. norming procedures, the subjects involved in the Clifton et al. norming procedure and experiments were undergraduate students of the University of Massachusetts.

On the view that the strength of different frames is determined by the different speech communities that the subjects belong to, we would therefore expect that the Clifton et al. results would reflect the Connine et al. results. Of the twenty-three verbs used in the Clifton et al. experiment, fifteen were also tested in the Connine et al. experiments. When we compare these fifteen verbs in the two experiments, it turns out that of the eight verbs which are taken to be preferred transitive by Clifton et al. two were found to be preferred intransitive by Connine et al. (*race* and *fight*); and of the seven verbs found to be preferred intransitive by Clifton et al., two were found to be preferred transitive (*signal* and *stop*) by Connine et al.; one was found to be preferred transitive in one experiment and preferred intransitive in the other (*study*), and one was found to be equal between transitive and intransitive in one experiment, although it scored slightly higher for intransitive in the second experiment (*play*). Moreover, Clifton et al. use two verbs, *call* and *study*, as having transitive bias in their first experiment, while they use the same two verbs as having intransitive bias in their second experiment. If it cannot be shown convincingly that the verbs used in the first

Clifton et al. experiment actually have transitive-intransitive bias, then it is doubtful that we can take the results of this experiment as constituting evidence for lexical preference.

If the results of this experiment are not due to lexical preference, the question arises why there are significant differences in reaction times for the two groups of verbs. A factor that could play a role in these results is that the verbs used in the experiment are not homogeneous in what they can express. On the one hand, we find verbs like *read*, *watch* and *call*. *Read* implies that the subject is reading some reading material, independent of whether the verb is used transitively, as in *John read a book*, or intransitively, as in *John read all night*. Moreover, for verbs like *read* the thematic role of the subject stays the same whether or not there is an overt object present. On the other hand, we find ergative/causative verbs, for which the different subcategorization frames are linked to differences in thematic structure. For example, *hurry* used intransitively expresses that the subject does the hurrying, as in *Ann hurried to school*; whereas *hurry* used transitively expresses that the subject causes the object to hurry, as in *Ann hurried the children to school*. Because these differences in thematic structure give us different interpretations, we have to ask whether verbs like *hurry* are represented in the mental lexicon as single entries or as different entries reflecting the different thematic structures. If the latter is the case, verbs like *hurry* would be processed differently from verbs like *read*. In processing verbs like *hurry*, the processor would have to disambiguate the verb, which might involve conceptual information, and thereby increase processing time. Furthermore, if consistent preferences are found for verbs like *hurry*, these could signify a preference for one thematic structure over another, rather than a preference for one subcategorization frame, as might be the case if consistent preferences are found for verbs like *read*.

Some light is thrown on this question by Stowe (1989), who reports on some experiments concerning ergative/causative verbs. Using a word-by-word grammaticality decision task, Stowe presented subjects with sentences in which the subject is either animate or inanimate, as in (3.21):

3.21a. Before the police stopped the driver was already getting nervous.

b. Before the truck stopped the driver was already getting nervous.

Stowe argues that the agent of ergative/causative verbs is typically animate, because it is obligatorily intentional. Because of this an inanimate noun cannot felicitously be assigned the agent role but can be assigned the theme role. Since these differences in thematic role are correlated with differences in syntactic structure, it is possible to test how these sentences are processed. If lexical preference is used in processing these sentences then we would expect that subjects would go for the same analysis for both (3.21a) and (3.21b), i.e. if the preferred frame of *stop* is the transitive, then we would expect subjects to be garden-pathed in both sentences, whereas if the preferred frame of *stop* is the intransitive, then we would expect subjects not to get garden-pathed in either of the two sentences. A second possibility could be that lexical preference interacts with plausibility. On this view, if the preferred frame of *stop* were the transitive frame, we would expect subjects to garden-path in sentences like (3.21a). However, we would also expect an increase at the verb or at the object noun phrase, due to the preferred frame being rejected and the intransitive frame being accessed. If the preferred frame of *stop* were the intransitive frame, the results should be the other way around. On the other hand, if both subcategorization frames become available, or if these different frames are stored as different lexical entries, and subjects decide for one or the other, depending on the animacy/inanimacy of the subject, then we would expect subjects to garden-path in (3.21a), but not in (3.21b). This is exactly what Stowe found:

	CONTEXT		AMBIGUOUS		DISAMBIGUATING	
	Police/ truck	stopped	the	driver	became	very
ANIMATE	691	757	678	759	1420	820
INANIMATE	697	724	687	747	811	777

Mean RTs in ms.

The interaction between animacy and ambiguity was significant, while there were no other significant differences at any position tested.

What this result shows, is that lexical preference is not used for ergative/causative verbs, but rather that the different frames become available and a choice has to be made between them. This result still leaves us with two possibilities concerning how these verbs are represented in the lexicon, and what this means for the lexical preference view. If these verbs are stored as different lexical entries, which both get accessed, then this result cannot shed light on

whether lexical preference is used for verbs other than ergative/causative verbs. On the other hand, if these verbs are stored as single lexical entries, of which the different subcategorization frames become available simultaneously, then this result does not support the view that lexical preference is used in processing.

When we look at all verbs used in the first Clifton et al. (1984) experiment, it turns out that of the eleven verbs claimed to be preferred transitive, three verbs have different thematic structures depending on whether they are used transitively or intransitively (*clean*, *race*, and *hide*). Of the twelve verbs claimed to be preferred intransitive, four verbs have different thematic structures depending on whether they are used transitively or intransitively (*stop*, *hurry*, *worry*, and *stand*), whereas for one verb, *consult*, the intransitive expresses 'to work as a consultant', as in *Ann consults for a big firm*, and the transitive expresses 'to go to someone/something for information', as in *Ann consulted her doctor.*[2] This means that (given Stowe's (1989) findings concerning ergative/causative verbs) in the processing of more than a third of the verbs used, lexical preference does not seem to play a role. Moreover, since only reaction times collapsed over the two groups of verbs (preferred transitive/preferred intransitive) are given, we cannot evaluate what these findings signify, or how the ergative/causative verbs compare to the rest of the verbs used.

In the second experiment, Clifton et al. tested the assumption that lexical preference is used in processing sentences with gaps (empty positions in the constituent structure) and fillers (lexical items that control the interpretation of the gap). They assume that if the preferred lexical frame of a verb is the transitive, then a gap will be postulated immediately following the verb, whereas if the preferred lexical frame of a verb is the intransitive, no gap will be postulated immediately following the verb. If this is the case then one would expect faster reading times for sentences in which the postulated gap coincides with the actual gap, whereas one would expect slower reading times for sentences in which the postulated gap differs from the actual gap, because reanalysis would have to take place.

In this experiment, sentences were presented word by word on a screen. At the end of the sentence a full-stop appeared after which the subjects made a grammaticality judgment concerning the sentence, by pushing one of two buttons. Sentences were made up in four

categories, transitive sentences containing a subordinate clause with a lexical head as in (3.22a), transitive sentences with a headless relative clause, as in (3.22b), intransitive sentences containing a subordinate clause with a lexical head as in (3.23a), and intransitive sentences with a headless relative clause, as in (3.23b):

3.22a. Transitive sentences, lexical head.

Tommy's girlfriend was impressed by the car that Tommy built/stole/drove ____ at the racetrack.

b. Transitive sentences, headless relative.

Tommy's girlfriend was impressed with what Tommy built/stole/drove ____ at the racetrack.

(verbs: pure transitive, biased transitive, biased intransitive)

3.23a. Intransitive sentences, lexical head.

The guests were upset by the vicious dogs they had to tiptoe/hurry/pass quietly by ____.

b. Intransitive sentences, headless relative.

Nobody told the visitors what they should tiptoe/hurry/pass quietly by ____.

(verbs: pure intransitive, biased intransitive, biased transitive)

In the transitive sentences, Clifton et al. used three types of verbs, verbs they took to be purely transitive, verbs they found to be preferred transitive, and verbs they found to be preferred intransitive. The expectation was that verbs which were purely transitive or biased transitive would elicit faster reaction times in these sentences than verbs that were preferred intransitive. In the intransitive sentences, again three types of verbs were used, purely intransitive verbs, biased intransitives and biased transitives. For these sentences the expectation was that the purely intransitive verbs and biased intransitives would elicit faster response times than the biased transitive verbs. However, as was the case with their first experiment, we cannot be sure that the verbs claimed to be preferred transitive or intransitive by Clifton et al. actually have this preference. As noted above, although the results of the same norming procedure were used for the two experiments, two verbs which were used as being preferred transitive in the first experiment, *call* and *study*, were used as being preferred intransitive in the second experiment. The verb *send*, which was classified as being preferred transitive in

the first experiment, had become a pure transitive in the second experiment. Furthermore, as was the case in the first experiment, a number of verbs differed in preference when compared to the Connine et al. (1984) findings.

According to Clifton et al., their stimulus sentences were constructed in such a way that the lexical fillers used were pragmatically appropriate for the gaps, while the Wh-fillers were neither particularly appropriate nor inappropriate, being lexically nearly empty. It would seem, however, that several sentences are pragmatically more complex than others, i.e. the reader has to make a number of extra assumptions in order to interpret them. For example, in order to interpret the sentence in (3.24) the experimental subject has to make the assumptions that the letter involved is discussed in some other written material, and that the teacher read from this other written material to the children:

3.24. The teacher was thinking of the letter that she had read to the children about.

When we compare this to the sentence in (3.25), it turns out that in order to understand (3.25) no such extra assumptions need to be made:

3.25. The teacher was thinking of the letter that she had complained to the children about.

In order to interpret (3.26) the reader has to make an assumption such as that the teacher involved has been told to complain about something to the children, or that the teacher involved thinks it is a good thing to complain to the children from time to time:

3.26. The teacher wondered what she should complain to the children about.

What we see then is that for a complete interpretation of a sentence more is involved than just assigning the filler to the correct gap, and that for some sentences this may involve making more assumptions than for other sentences. On the view that the inferential process involves processing time as well as the process of assigning structure to the sentence, this means that we cannot be sure whether the reaction times for the sentences reflect the one rather than the other.

Clifton et al. say that their results support the claim that lexical preference plays a role in comprehension, because:

> "*Congruence between preferred verb frame and sentence syntax facilitated the processing of filler-gap sentences early enough to affect a speeded grammaticality judgment task (or incongruence interferes with them).*" (Clifton et al., 1984, p. 705).

However, only the results in one condition (transitive sentences with a Wh-phrase filler) bear out Clifton et al.'s expectation. In both the intransitive sentences with a Wh-filler and with a lexical filler, reaction times are faster for the incongruent verbs than for the congruent verbs, which is incompatible with the view of Clifton et al.; for the transitive sentences with lexical fillers the reaction time for the incongruent verbs is even faster than for the 'pure' transitives, which again goes against the view of Clifton et al.[3]:

Sentence form	Wh-phrase filler			lexical filler		
	Pure	Con	Incon	Pure	Con	Incon
Transitive	932	1055	1208	1081	1085	1027
Intransitive	1189	1219	1209	1216	1254	1245

Mean Reaction Times in ms. for sentences judged grammatical.
("Pure" indicates pure transitive or intransitive verbs, as appropriate; "Con" indicates congruence between preferred verb frame and sentence syntax; and "Incon" indicates incongruence between preferred verb frame and sentence syntax.)

Clifton et al. do not comment on the findings for the intransitive sentences. Concerning the findings for the transitive sentences with lexical fillers they say that:

> "*(...) the transitive sentences of Experiment 2 that had lexically informative fillers showed no lexical expectation effect. The difference between wh-fillers and lexical fillers suggests that when a filler has already been identified, the processor may use information about the pragmatic fit between the filler and a potential gap rather than subcategorization information in deciding whether to postulate the gap. Thus, pragmatic information relevant to the current sentence may overcome lexical expectations based on a verb's preferred lexical form assessed independently of the current sentence.*" (op. cit., p. 706).

However, this does not explain why the incongruous verbs actually yielded faster reaction times than the 'pure' and congruous verbs.

Even if we take the Clifton et al. results at face value, they do not support the claim that lexical preference influences sentences comprehension, since only one of the four conditions tested shows results which are compatible with the claim. We cannot be sure that

the verbs used in the experiments actually have the preferences they are claimed to have, nor has it been shown that the purported preferences in production are the same as preferences in comprehension. Furthermore, given that differences in reaction times may be influenced by sentences being more or less pragmatically complex, it is unclear what exactly has been tested in these experiments.

We can show that experiments like the ones discussed above cannot constitute evidence for lexical preference by comparing experimental findings of Tanenhaus, Stowe and Carlson (1985) and Tanenhaus, Boland, Garnsey and Carlson (1989). In both papers the authors report on experiments conducted to establish whether lexical preference plays a role in sentences containing fillers and gaps along the lines of Clifton et al. (1984). Sentences were constructed containing early and late gaps, in order to see whether lexical preference caused the subjects to garden-path. In addition, sentences were made up with plausible and implausible fillers, to see whether these would give rise to a plausibility effect. Examples of the different sentences are given in (3.27) and (3.28):

3.27a. The sheriff wasn't sure which (horse, rock) the cowboy raced ____ down the hill. (early gap).

b. The sheriff wasn't sure which (horse, rock) the cowboy raced desperately past ____. (late gap).

3.28a. The district attorney found out which (witness, church) the reporter asked ____ about the meeting. (early gap).

b. The district attorney found out which (witness, church) the reporter asked anxiously about ____. (late gap).

Sentences were presented on a screen and subjects were asked to indicate whether or not they understood each sentence.

Although both Tanenhaus et al. (1985) and Tanenhaus et al. (1989) say that they relied on the findings of Connine et al. (1984) concerning lexical preferences of verb frames, we see that whereas Tanenhaus et al. (1985) take *race* to be preferred transitive, and *ask* to be preferred intransitive, Tanenhaus et al. (1989) claim exactly the opposite, namely that *race* is preferred intransitive, whereas *ask* is preferred transitive.

The results reported in the two papers were the following:

Tanenhaus et al. (1985): % sentences judged comprehensible.

Verb expectation:	transitive, e.g. 'race'		intransitive, e.g. 'ask'	
	early gap	late gap	early gap	late gap
Plausible filler	76%	65%	66%	85%
Implausible filler	58%	51%	45%	81%

Tanenhaus et al. (1989): % sentences judged comprehensible.

Verb expectation:	transitive, e.g. 'ask'		intransitive, e.g. 'race'	
	early gap	late gap	early gap	late gap
Plausible filler	83%	79%	64%	83%
Implausible filler	64%	64%	47%	85%

What we see then is that, although the results of the different experiments are quite similar, they are based on contrasting assumptions concerning preferences for transitive-intransitive verb frames. Unfortunately, neither Tanenhaus et al. (1985), nor Tanenhaus et al. (1989) give the full range of verbs they used with their purported preferences, so that we cannot fully evaluate their findings.

A number of experiments have been conducted to test whether there is a difference in processing sentences like (3.29), depending on whether the verb used has 'direct object-bias' (NP-bias), or whether the verb has 'complement-bias' (clausal bias):

3.29. The historian (suspected/read) the manuscript of his book ...

On the view that lexical preference is used, one would expect that in (3.29) the NP *the manuscript of his book* would be interpreted as a direct object, if the preferred frame of the verb is the simple transitive, whereas it would be taken as the subject of a complement clause, if the preferred frame of the verb is the one which takes a complement clause. Furthermore, one would expect that this difference would disappear when a full complement clause (containing *that*) is used, instead of a reduced complement clause (without *that*).

Mitchell & Holmes (1985) tested twelve sentences similar to the one in (3.29) but all having a complement clause continuation, containing eleven different verbs. In order to establish verb preferences they conducted a preliminary questionnaire study (conscious preference judgment task) along the lines of Ford et al (1982), discussed above. Although for ten of the eleven verbs they found reasonably strong preferences one way or the other, for *discover* they found NP-bias in one sentence, and clausal-bias in another. In the experiment *discover* appears both as an NP-bias verb and as a clausal-bias verb. The sentences were read by subjects in a phrase-by-phrase self-paced task. Mitchell & Holmes found that reading times for the disambiguating

phrase were much longer following verbs with an NP bias than following verbs with a clausal bias. This difference disappeared in a subsequent experiment in which *that* was inserted in the sentences. These results then seem to support the claim that lexical preference is used in processing these sentences. However, Holmes, Kennedy & Murray (1987) observe about this that:

> "*(...) a possible problem for this interpretation is created if one examines performance for each verb type with and without the complementizer across their two experiments. This comparison indicates that, for verbs with a direct-object bias, the addition of the complementizer appeared to speed up viewing time, whereas for verbs with a complement bias, it increased viewing time. It is hard to understand why the presence of the complementizer might slow down reading times for items assumed to be already biased towards a complement interpretation. Mitchell and Holmes' conclusion would have been more convincing if they had compared reduced and unreduced complement versions of the same sentence in the one experiment and had found garden-pathing only for the verbs with a direct-object bias.*" (Holmes et al., 1987, p. 287).

Holmes et al. (1987) report on an experiment they conducted to test whether insertion of a complementizer made a difference to the way in which subjects process a sentence. They presented subjects with three types of sentences, as in (3.30):

3.30a. The maid disclosed/ the safe's location within the house/ to the/ officer. (transitive).

b. The maid disclosed that/ the safe's location within the house/ had been changed. (full complement).

c. The maid disclosed/ the safe's location within the house/ had been/ changed. (reduced complement).

Sentences were presented word by word in a self paced reading task. No difference was made between possible biases of the verbs involved.

Holmes et al. found that at the disambiguating point after the the ambiguous noun phrase, longer reading times were obtained for reduced complement constructions compared with direct object sentences. However, longer reading times were also obtained for the sentences containing full complements compared to the direct object sentences. Furthermore, the reading times for the reduced and full complements were almost identical. These findings cannot be the result of subjects garden-pathing in the complement sentences, because then the effect should only show up in the sentences with a reduced complement, and not in those with a full complement. Holmes et al. suggest that

this increase in reading time may be due to the additional complexity of having to process an additional clause.

Holmes (1987) reports on an experiment, similar to the one of Holmes et al. (1987), but in which verbs were used according to lexical preference. This experiment is described in more detail in Holmes, Stowe and Cupples (1989). In order to establish lexical preference, subjects were asked to complete sentence fragments like *She believed....* Sixteen verbs were found that showed NP-bias, and sixteen that showed clausal bias. However, as we saw above, preferences found in a sentence completion task like the one used by Holmes (1987), are not necessarily the same preferences as the ones used in comprehension - if preferences are used at all. Besides, when we compare the results obtained by Holmes (1987) with the results of Connine et al. (1984), we see that of the eight clausal-bias verbs tested by both Holmes and Connine et al. five are found to have NP-bias by Connine et al. instead of clausal bias, although the results for the NP-bias verbs tested by both are roughly similar.

In order to check whether pragmatic plausibility has an effect on how sentences are processed, sentences were made up in different categories, containing plausible and implausible NPs. To establish the pragmatic plausibility or implausibility of objects, Holmes conducted a preliminary test in which subjects were given sentences, as in (3.31):

3.31a. The tenant remembered the reply.
b. The tenant remembered the smoke.

Subjects were asked to rate the sentences according to plausibility. Sentences like (3.31a) were found to be rated as highly plausible, whereas sentences like (3.31b) were found to be rated as implausible. On the basis of these ratings Holmes constructed sentences as in (3.32) and (3.33):

3.32a. The reporter saw (that) her friend was not succeeding.
(NP-bias verb, plausible object).
b. The reporter saw (that) her method was not succeeding.
(NP-bias verb, implausible object).

3.33a. The candidate doubted (that) his sincerity would be appreciated.
(Clausal-bias verb, plausible object).

b. The candidate doubted (that) his champagne would be appreciated.
(Clausal-bias verb, implausible object).

The sentences were presented on a screen, word by word, in a cumulative fashion. After each word subjects had to decide whether the sentence could continue grammatically, by pushing a button.

The results of the experiment appear to support the view that lexical preference plays a role in the processing of these sentences, i.e. reading times increased sharply at the verb following the subject of the complement clause in the NP-bias reduced complements, whereas there was only a slight increase at the same point in the Clausal-bias verb reduced complements, and no increase in both kinds of sentences containing full complement clauses.

However, these findings can be contrasted with findings of Kennedy, Murray, Jennings & Reid (1989). Kennedy et al. report on an experiment they conducted, using the same materials as Holmes et al. (1987), but incorporating the verbs with different biases as used by Holmes (1987). In this experiment sentences were presented as a whole on one line on a screen, and eye-movements were recorded.

Kennedy et al.'s findings are almost identical to Holmes et al. (1987):

Mean Total Pass per Word Reading Time (msec) for each Sentence Type and Verb Bias.

Sentence Type	Bias	Zone 1	2	3
Transitive	Comp.	220	201	227
	NP	232	201	283
That clause	Comp.	236	198	263
	NP	225	198	293
Reduced clause	Comp.	222	209	267
	NP	240	199	283

The zones under consideration were divided into a zone including the verb (1), a zone containing the 'object' NP (2), and a disambiguating zone (3), as in (3.34):

3.34. The workers considered/ the last offer from the management/ of the/ factory.

Both the sentences containing reduced complements and the sentences containing full complements took longer to process than the sentences containing direct objects. Moreover, Kennedy et al. found that the

purported verb biases did not have the effect expected if lexical preference is used in processing these sentences. They found that in all three sentence types the disambiguating zone took longer to read when NP-bias verbs were used than when clausal-bias verbs were used. On the lexical preference view, one would expect this to be the case for the sentences containing reduced complements, but not for the sentences containing direct objects, for which the lexical preference view would predict that the sentences containing clausal-bias verbs would take longer to process than the sentences containing NP-bias verbs.

There are two major differences in the results of Holmes (1987) and Kennedy et al. (1989): there is a significant difference between the processing of sentences with full and reduced complements in Holmes's experiment, but not in Kennedy et al.'s experiment. Also, Holmes finds support for the lexical preference view, while Kennedy et al. (1989) do not. Why should these experiments give us such different results?

To account for the first difference, we have to look at how the different experiments were conducted. One major difference between the two experiments is that in the Kennedy et al. experiment, subjects' eye-movements were measured, while they were reading the sentence which was presented as a whole. In the Holmes experiment, the sentence was presented word by word, and subjects had to make a grammaticality judgment after each word. The method of presentation and the nature of the experimental task can clearly have a strong influence on the results of the experiment (see, e.g. Just, Carpenter & Woolley, 1982; Kennedy & Murray, 1984; Pynte, Kennedy, Murray, & Courrieu, 1988). In Kennedy et al.'s experiment, the subjects' task is simply to read the sentence, which, at least partly, reflects a normal reading process; in Holmes's experiment, on the other hand, the subjects are engaged in an activity which does not reflect the normal reading process. It may well be the case that the demand for a grammaticality judgment after each word influences the way in which subjects process the sentence. This could have as a consequence that linguistic clues could play a more decisive, or different, role in Holmes's experiment as compared to Kennedy et al.'s experiment. For example, the complementizer *that* signals to the processor that a complement clause is going to follow. The absence of the complementizer could therefore bias subjects to a direct object reading, rather than to a complement clause reading, since the subjects are not provided with a context in

which they are encouraged to consider a complement continuation. It may well be the case that in Kennedy et al.'s experiment the absence of the complementizer does not play as big a role in how the sentence is processed as in Holmes's experiment, because the sentence is presented as a whole, so that subjects have more clues as to the continuation of the sentence. In Holmes's experiment, the subjects cannot look ahead to how the sentence continues, and, because they have to make a grammaticality judgment, a definite choice has to be made on encountering the NP, so that the presence or absence of the complementizer may have more weight in these sentences. This then could be an explanation of why there is a marked difference between the processing of sentences with full and reduced complements in Holmes's experiment, but not in Kennedy et al.'s experiment.

The second difference between Holmes's experiment and Kennedy et al.'s experiment is that Holmes's experiment gives rise to results that seem to support the lexical preference view, and Kennedy et al.'s experiment does not. To account for this we have to look at Holmes's findings concerning 'pragmatically plausible' and 'implausible' sentences, and at the nature of the verbs involved in the experiments.

In order to test whether pragmatic information influences initial structural choices, Holmes used NPs which could function as plausible and implausible objects. Because Holmes found that in the reduced implausible 'NP-bias' sentences, reading time increases at the disambiguating word in the same way as in the reduced plausible 'NP-bias' sentences, she concludes that pragmatics does not influence the way in which structure is assigned to these sentences. However, although a sentence like (3.31b), repeated here, may be judged to be pragmatically implausible, it becomes a lot more plausible with a continuation as in (3.35):

3.31b. The tenant remembered the smoke.
3.35. The tenant remembered the smoke billowing out of her flat.

Even a sentence like (3.36) which may be judged unacceptable:

3.36. The secretary read the fashion.

becomes perfectly plausible, when *fashion* is not the last word in the sentence as in (3.36), but is followed by, for example, *magazine*, as in (3.37):

3.37. The secretary read the fashion magazine.

When we compare the reduced implausible 'NP-bias' sentences with the reduced implausible 'clausal-bias' sentences, it turns out that for almost all implausible 'NP-bias' sentences a continuation is possible which turns the NP into a plausible direct object, as in (3.35) and (3.37) above, whereas for most of the implausible 'clausal-bias' sentences no such continuation is possible, e.g. ? *The candidate doubted his champagne ...* This has as a consequence that if the absence of the complementizer biases the subjects towards a direct object reading of the sentences, then in the NP-bias sentences there is nothing to tell them this will lead to a garden-path, whereas in the implausible 'clausal-bias' sentences, the implausibility of a direct object continuation may lead the subjects to go for a complement reading. When we look at Holmes's findings, we see that in both the implausible 'NP-bias' and 'clausal' bias sentences there is an increase in reading time at the nouns compared to the plausible conditions. Because a grammaticality judgment has to be made at this point, we can take these findings as indicating a decision about possible continuations. When we compare the plausible and implausible 'clausal' bias sentences, we see that whereas there is an increase in reading time at the disambiguating word in the plausible sentences, there is actually a decrease in reading time at the disambiguating word in the implausible sentences, pointing to a decision already having been made. This means that pragmatic processes play a role in how these sentences are analyzed, contrary to Holmes's claim that the analysis is made only by use of lexical preference.

The question remains why Holmes's findings show a sharp increase at the disambiguation point for sentences with 'NP-bias' verbs but not for plausible sentences with 'clausal-bias' verbs, which seems to support the lexical preference view. We saw that Kennedy et al. found that this is the case even when the verbs appear in sentences containing direct objects, for which the lexical preference view would predict that the sentences containing 'clausal-bias' verbs would take longer to process that the sentences containing 'NP-bias' verbs. When we look at the verbs used in the experiments, we see that there is a difference between the group of 'NP-bias' verbs and the group of 'clausal-bias' verbs, in that eleven out of the sixteen 'NP-bias' verbs have different senses in the direct object and complement readings of the tested sentences, i.e. *urge, judge, show, answer, see, hear, recognize, expect, understand* and *find.* For example, *find* can express something like 'to discover an object by searching', as in: *the doctor found the*

label, or it can express something like 'to learn or discover (a fact that was not known)', as in: *the doctor found that the fever had disappeared completely.* When we compare this to the 'clausal-bias' verbs, we see that the same only holds for two out of sixteen verbs, i.e. *claim* and *argue.* This means that in most of the sentences with 'NP-bias' verbs, subjects not only have to decide on which syntactic construction to go for, but also which sense of the verb is being used. On the other hand, in most of the sentences with 'clausal-bias' verbs, the subjects only have to decide on the syntactic structure, while the sense of the verb stays the same. This indicates that the difference in Holmes's reading time is due to the fact that in the 'NP-bias' sentences subjects not only have to recover from a syntactic garden-path, but also from a semantic garden-path, whereas in the plausible 'clausal-bias' sentences subjects only have to recover from a syntactic garden-path, without this changing the semantics in a significant way. This proposal is supported by Holmes's (1987) findings: there is a substantial increase in reading time at the disambiguating word in the reduced plausible sentences with 'NP-bias' verbs (403 msec.). However, there is also an increase in reading time at the disambiguating word in the reduced plausible sentences with 'clausal-bias' verbs, although much less then in the sentences with 'NP-bias' verbs (110 msec.). On the lexical preference view this result cannot be explained, since we would expect the findings for the 'clausal-bias' verbs in the reduced plausible sentences to mirror those in the unreduced plausible sentences, which show a decrease in reading time at the disambiguating word.

In Kennedy et al.'s experiment, we see that reading times are longer for sentences containing 'NP-bias' verbs than for sentences containing 'clausal-bias' verbs in all three sentence types. As we saw above, on the lexical preference view, we would expect sentences with a direct object containing 'NP-bias' verbs to take less time than the ones containing 'clausal-bias' verbs. However, on the view that the 'NP-bias' verbs are semantically more complex than the 'clausal-bias' verbs (because the 'NP-bias' verbs are semantically ambiguous as well as syntactically), the Kennedy et al. findings are not puzzling, but can be taken as pointing to greater processing cost for processing complex verbs than for processing more simple verbs.

We see then that neither tasks like conscious preference judgments and sentence completion tasks, nor experiments based on findings from these tasks give us convincing evidence for the claim that lexical

preference is used in processing, whereas the findings of Kennedy et al. (1989) seem to point to lexical preference not being used in processing.

Further evidence against the lexical preference view comes from Nicol & Osterhout (1988), as reported in Nicol & Swinney (1989). Nicol & Osterhout examined reactivation patterns using a cross-modal priming paradigm. This cross-modal priming paradigm is an on-line testing technique whereby sentences are presented auditorily, and subjects are asked to make a lexical decision to visually presented word/nonword targets.

Nicol & Osterhout used sentences such as in (3.38), in which the target was presented at the *:

3.38a. That's the actress that the dentist from the new medical centre in town had invited * to go to the party.

b. That's the actress that the dentist from the new medical centre in town had planned * to go to the party with.

They found that there was priming for *actress* immediately following *planned* as well as following *invited*, even though *plan* can only occur with an inanimate direct object, (with one exception: *The baby was planned*), e.g.

3.39a. Michelle planned a party.

b. *Michelle planned the actress.

Lexical preference proponents could argue that the preferred reading of *plan* happens to be the transitive reading. However, Nicol (1988) conducted a follow-up study which contrasted 'quasi-intransitive' verbs like *plan* (which can appear transitively and intransitively), and true intransitives such as *hesitate*. This study shows that significant priming of the head of the relative (e.g. actress in (3.38)) always occurs after the 'quasi-intransitives', but not after the true intransitives. This result then shows that a gap is postulated after 'quasi-intransitive' verbs, even when it is inappropriate, as in the case of the verb only taking an inanimate object and the head of the relative referring to an animate object. These findings indicate that the view that verbs are stored and accessed according to lexical preference is not tenable; whenever a verb can be used transitively, a gap will be postulated.

What we have seen above is that there is no evidence which supports the assumption that verb subcategorization is used according to lexical

preference, and that there is at least some evidence (Kennedy et al., 1989; Nicol, 1988) against the lexical preference view. With models of comprehension based on lexical preference ruled out, we are left with the alternative that in processing some input verb all the subcategorization frames are recovered and a choice is made among these (parallel access). As we saw at the beginning of this chapter, this still leaves us with two possibilities; the possibility that subcategorization information guides the processor in assigning structure to the input, and the possibility that the processor first assigns a structure to the input using some different strategy, and then uses subcategorization information to check the consistency of the structure. In the next section, we will look at experimental findings which bear on this question.

3.2. Parallel access.

The findings of Nicol & Osterhout (1988), and Nicol (1988) discussed above, throw some light on the question of whether subcategorization information guides the processor in assigning structure or not. In both experiments sentences were tested containing fillers and gaps, such as (3.38), repeated here:

3.38. That's the actress that the dentist from the new medical centre in town had planned/invited * to go to the party.

On the view that subcategorization information is used to check an initial structure assignment rather than to guide the initial structure assignment, we would expect that gaps are not proposed immediately after encountering the verb, but only when no other gap is found to assign the filler to (as proposed by Frazier, Clifton & Randall, 1983; and Clifton & Frazier, 1986). However, Nicol's (1988) and Nicol & Osterhout's (1988) experiments show that gaps are proposed immediately after the verb is encountered, at least for those verbs which can take an object. This means that the processor must have access to subcategorization information on encountering the verb, and that it is guided by this subcategorization information in proposing or not proposing a gap.

Mitchell (1989) argues that the findings of Nicol (1988) and Nicol & Osterhout (1988) are not decisive. He argues that even though there was no significant priming following intransitive verbs, it could still be postulated that what priming there was was caused by the same

procedure as the priming in the case of transitive verbs. He goes on to say that:

> *"It could still have been argued that the gap-positing processes are equivalent for all types of verb, but that once filler information has been activated, this can be suppressed more rapidly when filtering operations reveal that the gap is ungrammatical."* (Mitchell, 1989, p. 144).

However, these arguments present a number of difficulties. What Mitchell is arguing for is an independent gap-positing process, which postulates a gap following any verb. However, this goes against the assumption that the parser follows the principle of Minimal Attachment, which Mitchell assumes to be responsible, together with the principle of Late Closure, for the initial assignment of structure to an input string (Mitchell, 1987, 1989; cf. Frazier, Clifton & Randall, 1983; Clifton & Frazier, 1986). The principle of Minimal Attachment predicts that no gap is postulated following any verb, since this would be a potentially unnecessary node. Only if the initial analysis cannot accommodate the filler, will a gap be postulated. More importantly, Mitchell proposes that a gap is posited after any verb, but filtering operations using lexical preference information come into play so rapidly that this shows up in the amount of priming a filler receives. This means that the only way in which we would be able to distinguish this proposal from the proposal that all subcategorization frames of the verb are activated, would be to show that no significant priming takes place following a preferred intransitive verb. However, this has not been shown by any of the experiments concerning lexical preference (as discussed above).

We can conclude from this that on encountering a verb all subcategorization frames of the verb are accessed in parallel, and that the processor assigns a structure to the input string on the basis of this. However, as was pointed out in the beginning of this chapter, models based on parallel access have been criticized in the literature, on the grounds that the predictions they make are not borne out. A well-known example of this model is Fodor, Garrett & Bever 's (1968) Verb Complexity Hypothesis. Fodor et al. proposed that on encountering a verb all syntactic subcategorization frames are accessed. The expectation was that the more complex a verb is, i.e. the more different subcategorization frames it has, the more perceptual difficulty there is in processing the sentence containing the verb, giving rise to increased processing time.

This expectation was tested by Hakes (1971), using the 'phoneme-monitoring technique'. Subjects read sentences and had to push a button on encountering a specific phoneme, such as /b/ in *book-keeper* in the sentences in (3.40):

3.40. The manager suspended (simple verb)/ suspected (complex verb) the book-keeper when he discovered that five thousand dollars was missing.

Furthermore, subjects were instructed to say in their own words what the sentence meant, after hearing it.

Hakes did not find any difference in monitoring times between the simple and complex verbs, but he did find that paraphrasing was more accurate for sentences containing simple verbs, than for sentences containing complex verbs.

This result has been used in the literature to conclude that parallel access of verb subcategorization information does not play a role in comprehension (e.g. Garnham, 1985; Mitchell, 1989). However, it is not clear that this conclusion is warranted. Hakes himself does not take his results as convincing evidence against parallel access of subcategorization information. He proposes two possible explanations for the results. It could be the case that the results show that subcategorization information only plays a role in later stages of processing (i.e. the checking model). A second explanation could be that a set of possible structural hypotheses is formulated while a clause is processed, based on subcategorization information, but that decisions among these hypotheses are made only after a clause boundary is reached. If this is the case, then the expected complexity effect should only show up at the end of 'bookkeeper' in (3.40), rather than at the beginning.

These are not the only alternative explanations that can be given for the findings. It could be the case that the task of listening for a phoneme and responding to it as quickly as possible influences the way in which subjects process the sentence. It may be that subjects do not process the sentence as fully as they would do normally, because their prime concern is recognizing the phoneme. Moreover, it is not clear whether all factors influencing the results have been taken into account in the interpretation of the results. Foss and Gernsbacher (1983) show that phoneme-monitoring time is positively correlated with the duration of the vowel following the target phoneme. They showed that target phonemes produced shorter monitoring times if they had

shorter vowels. However, Hakes (1971) does not mention this factor, and because he does not give us all the test sentences used, we cannot evaluate whether this could have influenced the results.

In order to get a better understanding of what is involved in comprehension concerning the use of verb subcategorization information, we have to take a step back and consider what it actually means to say that the processor makes use of verb subcategorization information. Fodor, Garrett & Bever (1968) proposed that on encountering a verb the processor recovers its syntactic subcategorization frame(s). For example, a verb like *arrest* subcategorizes for an NP, so that on encountering the verb the processor recovers the subcategorization frame:

arrest v[_ NP]

However, this is not the only possibility. An alternative is that it is not the syntactic subcategorization frame that is recovered, but rather a specification of the number of arguments that a verb can take. This proposal would make different predictions. For example, a verb like *send* has three syntactic subcategorization frames:

send v[_ NP
_ NP PP
_ NP NP]

These three subcategorization frames represent two different predicate-argument structures:

send (x,y)
(x,y,z)

This means that we can view verbs as being more or less complex depending on whether we take syntactic subcategorization frames or argument structure as a measure of complexity.

A second factor which has a bearing on verb complexity is the question of implicit arguments. It has been argued in the literature that, for example, a sentence like (3.41) implies that Ann sent a book to someone, even though this is not explicitly mentioned (e.g. Carrier-Duncan, 1985; Haegeman, 1987; Zubizarreta, 1985):

3.41. Ann sent a book.

A consequence of this could be that rather than having two predicate-argument structures, a verb like *send* only has one argument structure, namely the one with three arguments. This could mean that verbs which are complex in terms of syntactic subcategorization frames are simple in terms of argument structure.[4]

Shapiro, Zurif & Grimshaw (1987, 1989) conducted a number of experiments to establish whether syntactic subcategorization information or predicate–argument structure information is used in processing verbs. In their first experiment Shapiro et al. made up sentences containing verbs from five different categories. The first three categories contrast transitives, nonalternating datives and alternating datives:

(a) Transitives, i.e. verbs that take a single object NP, such as *cherish*. Verbs from this category have one subcategorization frame, [_ NP], and one argument structure, (x, y).

(b) Nonalternating datives, i.e. verbs that allow an NP PP, such as *donate*. Verbs from this category have two subcategorization frames, [_ NP], [_ NP PP], and two argument structures, (x, y), (x, y, z).

(c) Alternating datives, i.e. datives that also allow double-NPs, such as *send*. Verbs from this category have three subcategorization frames, [_ NP], [_ NP PP] and [_ NP NP], and two argument structures, (x, y), (x, y, z).

The last two categories of verbs used in the experiment contrast verbs that can occur with an object NP and with an S', where the S' is a that-clause, such as *accept*, with verbs that can occur with an object NP and with an S', where the S' is either a that-clause, an interrogative clause, or an exclamative clause, such as *know*. Shapiro et al. argue that these different clauses have distinct semantic properties, and will therefore be represented as separate argument structures of the verb. As a consequence the first group of verbs are taken to be 'two complement' verbs, which have two subcategorization frames, [_ NP] and [_ S'], and two argument structures, (x, y) and (x, P). The second group of verbs are taken to be 'four complement' verbs, which again have two subcategorization frames, [_ NP] and [_ S'], but four argument structures, (x, y), (x, P), (x, Q), and (x, E), where P ranges over propositions or that-clauses, Q ranges over interrogatives and E ranges over exclamations.

Shapiro et al. say that if one looks at verb complexity in terms of syntactic subcategorization, then the continuum for least to most complex will be: Transitives < Nonalternating datives = Two complements = Four complements < Alternating datives. However, if argument structure accounts for differences in verb complexity, then

the continuum for least to most complex will be: Transitives < Nonalternating datives = Alternating datives = two complements < Four complements.

Sentences were tested using the cross-modal lexical decision task, i.e. subjects heard sentences over earphones, and were presented a word/non-word on a screen in the vicinity of the verb, about which they had to make a lexical decision.

Shapiro et al. found that the results supported the claim that argument structure, rather than syntactic subcategorization information is used by the processor:

Mean RT's (in ms) for verb types

Transitives	Nonalternating datives	Alternating datives	Two complement	Four complement
626	672	679	676	731

The difference in reaction time between the transitives and the middle three categories was significant, as was the difference between the middle three categories and the four-complement verbs, while the differences among the middle categories was not significant. This seems like fairly strong evidence for the claim that argument structure information is used in processing verbs.

Unfortunately, the results turn out not to be so convincing when we look at the verbs that were used in the different categories. None of the categories of verbs is homogeneous, which means that it makes no sense to compare the different categories and draw conclusions on the basis of this. The five transitive verbs tested were: *secure*, *fix*, *measure*, *cherish* and *exhibit*. Of these five verbs two can actually be used as datives, *secure*, as in *He secured himself a good job*, and *fix*, as in *He fixed me a drink*; moreover, *exhibit* can be used intransitively as well as transitively, as in *She regularly exhibits at the Tate Gallery*. The five nonalternating datives tested were *surrender*, *address*, *return*, *restore* and *donate*. Of these, *surrender* can be used intransitively, as in *The enemy surrendered*, and it can subcategorize for a PP, as in *The army surrendered to the enemy*. *Address* has two senses, 'to write an address on something', as in *I addressed the envelope*, and 'to direct a speech at someone', as in *The politician addressed the audience*. Even though these different senses take the same argument structures, it could be postulated that subjects have to disambiguate the verb, which could account for an increase in processing time. *Return* is a causative verb, such as *hurry* (discussed above), which can be used intransitively, when it expresses that the

subject comes or gets back, as in *Spring will return.* Furthermore, it can be used as an alternating dative, as in *Don't forget to return me my keys*[5]. The five alternating datives used were *dig, buy, send, lend* and *reserve.* Of these *dig, buy* and *lend* can be used intransitively, while *send* can occur with an infinitive, as in *He sent to tell us he couldn't come,* and with a PP, as in *Send for a doctor.* The five two-complement verbs were *regret, assume, accept, claim* and *maintain.* Of these *assume, claim* and *maintain,* have a number of different senses. The five four-complement verbs were *discover, recognize, remember, state* and *indicate.* Of these *recognize* can occur with an NP and an infinitive, *remember* can occur with an infinitive, expressing 'to take care not to forget', and *indicate* can be used intransitively to express something like 'showing which way one is going in a car', as in *The driver forgot to indicate.*

In a second experiment, Shapiro et al. (1987) tested whether or not the syntactic realization of an argument has a bearing on verb complexity. They compared transitives, datives with an optional third argument and verbs with an obligatory third argument (e.g. *hand*), using the same cross modal lexical decision task as in the first experiment. They predicted that if verb complexity is determined by the number of argument structures a verb can take, then the obligatory three argument verbs should yield similar results as the transitive verbs, while the optional datives should yield longer reaction times. On the other hand, if implicit arguments are part of the same argument structure as explicit arguments, then optional datives and obligatory three argument verbs should yield similar reaction times.

Shapiro et al. got the following overall results, where the difference between the datives and the other two categories is significant:

Mean RTs (in ms) for verb categories

Transitives	Datives	Obligatory
622	647	606

These results seem to point at datives with optional arguments having the different argument structures represented separately. However, as was the case in the first experiment, the groups of verbs used were not homogeneous. The six transitives and six optional datives used, were mostly the same verbs as in the first experiment, while the group of obligatory three argument verbs consisted of six verbs, *hand, entrust, put, will, devote* and *place.* Of these, *will* can occur as a modal verb, and as a main verb with an NP and an infinitive, or with a that-

clause. The third argument of *place* is optional, as in *I placed an order for 500 shoes*, and even *put* can occur with an implicit third argument, as in *I put it rather strongly*, or *Why don't you put 'Yours sincerely'?* Since the verbs used in each category are not homogeneous, again it makes no sense to draw conclusions concerning verb complexity on the basis of these results.

When we compare the results for individual verbs from the first and second experiments, we see that some verbs got very similar results in both experiments; for example *measure* had a mean reaction time of 633 ms. in the first experiment, and 638 ms. in the second experiment. However, other verbs got widely different reaction times in the two experiments, some being much faster in the first experiment than the second, e.g. *secure* (1st experiment: 614 ms., 2nd experiment: 652 ms.), and *send* (1st experiment: 646 ms., 2nd experiment: 684 ms.), while others were much faster in the second as compared to the first, e.g. *dig* (1st experiment: 680 ms., 2nd experiment: 607 ms.), and *exhibit* (1st experiment: 638 ms., 2nd experiment: 593 ms.). These differences in reaction times for the verbs in the two experiments raise the question of how reliable this sort of reporting of findings is in giving us an insight in verb complexity. Although reaction times are given for individual verbs, they are collapsed over subjects. We might learn more if reaction times were given for individual subjects, and if the same subjects were tested repeatedly, so that it could be assessed whether differences in reaction times in different experiments are due to individual subjects showing differences, or different groups of subjects showing differences.

What we have seen then is that there is no experimental evidence to support the view that lexical preference is used in comprehension. Rather the evidence supports the view that subcategorization frames become available in parallel, and a choice is made among them. We can then ask what the nature of these subcategorization frames is, and whether they represent syntactic information, or some sort of argument structure. Unfortunately, the results of the few relevant experiments that have been carried out to date do not throw much light on this question.

Chapter 4: Conceptual structure.

In the last two chapters, we have seen that the experimental findings are not incompatible with Relevance theory predictions concerning on-line sentence processing. In this chapter, we will look at Relevance theory proposals about how conceptual representations are computed, and point out some problems with these proposals. To understand what is involved in full interpretation, we need an account of what constitutes conceptual structure. We will evaluate proposals by Jackendoff (1983) and Pinker (1990) concerning conceptual representations. This leads to the proposal that verbs are represented as structured concepts. This view of verb representation together with Relevance theory gives us an account of when arguments of verbs can be left implicit. Finally, an alternative proposal is made concerning how addressees compute conceptual structures on the basis of the linguistic input.

4.1. The Relevance theory approach to logical hypothesis building.

As we saw in chapter 1, Sperber & Wilson (1986) propose that in language comprehension the addressee recovers the logical form of a linguistic input. In order to fully interpret an utterance, this logical form has to be enriched to become a propositional form. For an account of real time utterance interpretation, this means that questions need to be answered concerning the nature of the logical form representation, how this logical form is recovered, and how it is completed into a fully propositonal form on-line. Concerning the first question, Sperber & Wilson propose that:

> *"a logical form is a well-formed formula, a structured set of constituents, which undergoes formal logical operations determined by its structure."* (Sperber & Wilson, 1986, p.72).

This notion of logical form is different from the level of LF such as proposed in a GB framework, where LF is defined as the level of grammar at which quantifier scope and other properties are directly represented (cf. Chomsky, 1981, 1986). In GB, this representation consists of lexical items and natural language syntax, whereas in Relevance theory logical forms are representations in the 'language of thought', i.e. well-formed formulae containing concepts and logical variables rather than lexical items. Sperber and Wilson assume that logical forms are trees of labelled nodes, and that the labels used are logical:

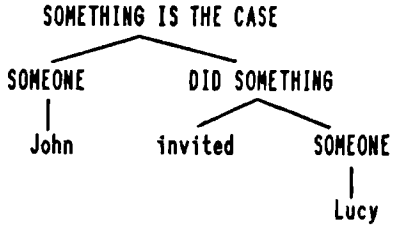
> *"The logical labels should be a set of basic logical categories, perhaps from a fixed range which is part of basic human mental equipment, which might be regarded as variables over conceptual representations of different types."* (op. cit., p.205).

They use the pro-forms of English to represent these variables, e.g. SOMEONE as a variable over conceptual representations of people.

As a simplified illustration of the logical form of a sentence like (4.1), they give (4.1a):

4.1. John invited Lucy.

4.1a.



Sperber & Wilson argue that, viewed in this way, the logical form of (4.1) carries the information that John did something, that John invited someone, etc.; in other words, a number of analytic implications of (4.1) can be read off the logical form representation directly.

According to Sperber & Wilson, in order to recover the logical form of an utterance in real time utterance interpretation, the addressee builds anticipatory logical hypotheses about the overall structure of the proposition expressed by an utterance. These hypotheses are needed by the addressee to enable her/him to resolve potential ambiguities and ambivalences. Sperber & Wilson assume that these logical hypotheses are built on the basis of anticipatory syntactic hypotheses, unless the addressee already has an incomplete logical form available which can function as an anticipatory logical hypothesis, as may be the case with, for example, answers to questions. Sperber & Wilson assume that after recognizing the first word of an utterance, the addressee assigns it to a syntactic category (e.g., NP), and then makes the anticipatory syntactic hypothesis that it will be followed by another syntactic category (e.g., NP —> VP). By variable substitution this then yields an anticipatory logical hypothesis, e.g., (NP(John) VP) —> 'John DO/BE/HAVE SOMETHING'. Sperber & Wilson say that:

> *"On this approach, there is a clear sense in which the logical category labels correspond to, and are indeed semantic interpretations of, syntactic category labels of*

natural language (though there need not be a one-to -one correspondence)." (op. cit., p.206).

However, this approach faces a number of problems. One problem is that Sperber & Wilson do not explain how the relationship between concepts and logical variables is represented. As we saw in chapter 1, Sperber & Wilson propose that conceptual addresses give access to different types of information - lexical, logical and encyclopaedic. The encyclopaedic entry of a concept contains information about the extension and/or denotation of the concept. The lexical entry gives access to information about the natural language counterpart of the concept, including its syntactic category membership. We might therefore expect that the logical entry would give information about the concept's logical category membership. However, this is not the case: Sperber & Wilson postulate that the logical entry consists of a set of deductive rules which apply to logical forms of which that concept is a constituent. It seems then that the logical category is only assigned to a concept indirectly, i.e. via the syntactic category membership of its linguistic counterpart. However, as Sperber & Wilson point out (see above), there is not necessarily a one-to-one correspondence between syntactic category and logical category labels, which raises the question of how the correct mapping of concepts onto logical categories is ensured.

Another problem that faces the approach sketched by Sperber & Wilson is that they do not explain how and on what basis syntactic hypotheses are formed; for example, whether these are built for each word, or only for major phrases. Sperber & Wilson say in respect to this:

"[the addressee] might not only identify each word and tentatively assign it to a syntactic category, but use his knowledge of its lexical properties and syntactic co-occurrence restrictions to predict the syntactic categories of following words or phrases." (op. cit., p.205).

As an illustration of how they envisage the process of hypothesis building, Sperber & Wilson give the example in (4.2):

4.2. Jennifer admitted stealing.

They assume that after *Jennifer* is recognized, it will be assigned to the syntactic category NP. On the basis of this the addressee makes the anticipatory syntactic hypothesis that it will be followed by a VP, which yields, by variable-substitution, the anticipatory logical hypothesis in (4.3):

4.3. Jennifer DID SOMETHING.

Sperber & Wilson assume that *Jennifer* has been assigned to NP straightaway, but this is not necessarily the only possibility. *Jennifer* is a noun, and although the addressee can make the anticipatory hypothesis that it is the whole NP, this need not be the case. S/he can use her/his knowledge of the lexical properties and co-occurrence restrictions of *Jennifer* to build the hypothesis that it will be followed by a surname (anticipatory syntactic hypothesis: N —> N), that it will be followed by a PP, or that it will be followed by a subordinate clause. In principle, these are all possible expansions of *Jennifer*. Since the addressee has no means of deciding which of these hypotheses will turn out to be the correct one, it follows that s/he will have to make a series of anticipatory syntactic hypotheses. This has as a consequence that not one logical hypothesis will be made, but that, by variable-substitution, the different syntactic hypotheses will yield a series of anticipatory logical hypotheses. Furthermore, when for example the anticipatory syntactic hypothesis (N —> PP) is made, there is not just one logical variable that can be used to substitute the PP in the logical hypothesis. Jackendoff (1983) identifies and justifies several basic 'conceptual' categories. At least four of these, PLACE, MANNER, TIME and PROPERTY can be realized by a PP. If we accept these, then the anticipatory syntactic hypothesis (N —> PP) would give us, by variable substitution, the following logical hypotheses:

4.4a. 'Jennifer SOMEWHERE ...'
b. 'Jennifer SOME MANNER ...'
c. 'Jennifer SOME TIME ...'
d. 'Jennifer SOME PROPERTY ....'

Although 'Jennifer SOME PROPERTY ...' and, arguably, 'jennifer SOMEWHERE ...' can be realized as natural language NPs, e.g.

(NP(NJennifer)(PPwith the big ears))
(NP(NJennifer)(PPfrom next door))

it is difficult to find natural language NPs which realize 'Jennifer SOME TIME ...'. MANNER is even more problematic, because it typically modifies actions, so that 'Jennifer SOME MANNER ...' cannot be realized by natural language NPs. This means that, unless one wants to say that there are constraints on which logical variables can be substituted for which syntactic category in which position in the

syntactic tree, one ends up with anticipatory logical hypotheses which are superfluous, in that they will never be realized.

Sperber & Wilson say that when the hearer recognizes *admitted*, s/he can make the anticipatory syntactic hypothesis that it will be followed by an NP, because it is transitive on both of its senses, *confess to* and *let in*. Again this is not the only possibility, because on its first reading, *admit* subcategorizes for S, S', PP (S'), and NP PP, as well as for NP. If anticipatory syntactic hypotheses are built for all these possibilities, they in turn give rise to an extended range of anticipatory logical hypotheses, taking into account that, as was the case with the PPs above, there is not necessarily a one-to-one correspondence between the logical category labels and the syntactic category labels.

That PPs are not the only syntactic categories which can map onto different logical categories, is illustrated in the next step in the process of hypothesis building for the utterance in (4.2). Sperber & Wilson give as anticipatory logical hypotheses built on the syntactic hypothesis (admitted —> NP):

4.5a. Jennifer let SOMEONE in.
b. Jennifer confessed to SOMETHING.

This again raises the question of how one knows which logical variable to substitute for which syntactic category, since (4.5a) has SOMEONE, a variable over people, whereas in (4.5b) SOMETHING is used, a variable over things. We see here that NPs can be realized by two logical variables. However, Jackendoff (1987) points out that NPs can express almost any conceptual category, for example, *earthquake* expresses an event, and *redness* expresses a property. If these conceptual categories are represented in logical variables, then any hypothesized NP would give rise to a wide range of logical hypotheses. Even if we presume that an NP is substituted by only two variables, as in (4.5a) and (4.5b), this would still give us four logical hypotheses, and besides it would have as an undesirable consequence that (admitted —> NP) would yield the logical hypothesis in (4.6):

4.6. Jennifer admitted (confessed to) SOMEONE. (in the sense of: *the thing that Jennifer admitted doing was someone).

Hypothesis (4.6) would be ruled out on the grounds of semantic incompatibility, so that postulating (4.6) as a hypothesis is superfluous.

Jackendoff (1983) proposes a variable THING which ranges over people

and things. Adopting this variable would circumvent the above problem, although it would not narrow down the range of possible referents that the logical variable can take in the way that (4.5a) and (4.5b) do.

Sperber & Wilson say that, after disambiguation of *admitted* has taken place,

> *"if the speaker has achieved optimal relevance, the word 'stealing' should fall into a place already prepared for it during the interpretation process."* (op. cit., p.208).

Stealing does fall into a place already prepared for it, but the question is whether it is the right place. According to the anticipatory logical hypothesis, *stealing* is a THING. However, *Jennifer admitted stealing* entails that it was Jennifer who did the stealing, not that what Jennifer confessed to was stealing 'in general'. This means that the NP *stealing* functions here as an elliptical sentence, which expresses an event in which Jennifer was involved. However, the anticipatory logical hypothesis proposed by Sperber & Wilson does not allow for this enrichment, so that it makes the wrong prediction.

Basing logical hypotheses on syntactic hypotheses can actually lead to false predictions in some cases. Consider the example in (4.7):

4.7a. A: I went to the pictures last night.
b. B: Me too.

After recognizing *me* the hearer assigns it to the syntactic category N and can then, because of its case, build the syntactic hypothesis (N —> conj. N), e.g. 'Me and John ...'. By variable substitution this will yield the anticipatory logical hypothesis 'speaker and SOMEONE ...'. Alternatively, *me* may be recognized as a displaced object, so that the syntactic hypothesis can be built that it will be followed by a sentence with an empty 'object-slot'. However, in neither of the two hypotheses is there a place into which *too* can be fitted, which will render *me too* uninterpretable. This would imply that a speaker aiming at optimal relevance would not utter *me too*; but surely one would want to say that B's response in (4.7) is more relevant than the alternative utterance in (4.8):

4.8. B: I went to the pictures last night too.

Although both utterances have the same contextual effects, the effort required to process (4.7b) is (intuitively) small, whereas processing

(4.8) takes more effort, which is not set off by any contextual effects.

In general, it seems that elliptical sentences present a problem as far as syntactic hypothesis building is concerned, because they induce the wrong hypothesis to be built, for example:

4.9. Hope to see you soon.
4.10. Police rescued from gang.

This can also happen with sentences with dislocated constituents, for example:

4.11. That film we saw on the ferry coming to Britain.

There is nothing about dislocated NPs that distinguishes them from ordinary subject-NPs, so that the wrong hypothesis (NP —> VP) will be built on recognizing them. Alternatively, we would be forced to adopt the view that for every first encountered NP in an utterance the hypothesis that it is dislocated would have to be built, as well as (NP —> VP), something which is clearly undesirable.

We see then that the proposal that anticipatory logical hypotheses are built on the basis of anticipatory syntactic hypotheses cannot be maintained. Postulating this way of hypothesis formation does not constrain the number of possible 'readings' of an utterance, but rather increases them. Because there is no one-to-one correspondence between syntactic categories and logical categories, postulating that a particular syntactic category will follow, gives rise to an extended range of logical hypotheses. Moreover, some of these logical hypotheses are unrealizable, as was the case with the logical hypotheses that could be built on the basis of (Jennifer —> PP).

A further problem that faces this proposal is that it gives rise to the wrong predictions, as we saw with, for example, the elliptical sentences above. If processing cost was no object, the addressee could build all possible hypotheses, even unrealizable ones, and discard all but the one which is borne out by further incoming information. However, Sperber & Wilson propose that anticipatory hypotheses are built to constrain the interpretation process, and thereby the amount of processing effort, so that this view of hypothesis formation is ruled out.

4.2. Logical hypotheses without syntactic hypotheses.

Sperber & Wilson's main claim concerning on-line language input processing is that:

> *"... the hearer makes anticipatory hypotheses about the overall logical structure of the utterance and resolves potential ambiguities and ambivalences on the basis of these."* (op. cit., p.205).

Logical hypotheses not only play an important role in disambiguation, but, since logical hypotheses are logical forms, they also allow the addressee to start drawing inferences as soon as one is constructed, i.e. the addressee does not have to wait until the end of the utterance to start achieving contextual effects. This property underlies a further important role of logical hypotheses in comprehension: they give us an account of such notions as the given-new and focus-presupposition distinctions. Sperber & Wilson propose that the smallest stressed constituent in an utterance be called the 'focally stressed constituent', and that the constituent that the stress highlights, is the 'focus'. They point out that the focally stressed constituent rarely determines a unique focus. For example, in (4.2), repeated below, the focally stressed constituent is *stealing*, but the focus could be *stealing* by itself, the VP *admitted stealing*, or the whole sentence *Jennifer admitted stealing*. By postulating that the addressee makes anticipatory logical hypotheses we can account for how the actual focus is chosen.

4.2. Jennifer admitted STEALING.

The correct logical hypotheses that an addressee recovers during the interpretation of an utterance are logically related to each other: *"the set of anticipatory hypotheses forms a scale in which each member analytically implies the immediately preceding member and is analytically implied by the immediately succeeding member."* (op. cit., p.208). For example, (4.2) gives us the scale in (4.12):

4.12a. Jennifer did something/
What did Jennifer do?

b. Jennifer confessed to something/
What did Jennifer confess to?

c. Jennifer confessed to stealing. (op. cit., p.210)

What we see then is that the scale in (4.12) is a subset of the analytic implications of (4.2). This subset of implications is related to the set of possible foci: by replacing the possible focus

with a logical label one gets an implication in the scale, so that the scale may be referred to as a 'focal scale'.

These implications can contribute to the overall relevance of an utterance in two ways; either an implication gives rise to contextual effects in its own right, or it helps reduce processing cost by giving direct access to a context in which contextual effects can be achieved. Sperber & Wilson propose that an implication which gives rise to contextual effects of its own is a 'foreground implication', and that an implication which does not give rise to contextual effects is a 'background implication'. On the basis of this distinction, Sperber & Wilson propose that:

> "...*the* focus *of an utterance will be the smallest syntactic constituent whose replacement by a variable yields a background rather than a foreground implication.*" (op. cit., p.209)

As a consequence, an utterance does not have a unique focus. Where the focus falls for an individual addressee depends on how the implications interact with the context that is accessed by the addressee.

This proposal also sheds light on the intuition that there is a gradient of given and new information:

> "... *Wherever the cut-off point between foreground and background comes, there is a clear sense in which [12b], for example, simultaneously acts as a foreground implication in relation to [12a], giving a partial answer to the question it raises, and as a background implication in relation to [12c], raising a question to which [12c] gives at least a partial answer. ...even [12c], which is necessarily a foreground implication, may simultaneously raise a background question which some subsequent utterance (or a continuation of the same utterance) will answer. Our distinction between foreground and background, like our notion of focus itself, is thus a purely functional one, and should play no role in the linguistic description of sentences.*" (op. cit., p.210).

Postulating that logical hypotheses are formed in the course of processing does not only give us an account of how disambiguation is achieved but also gives us an explanation for stylistic effects. However, as we have seen, the proposal that these hypotheses are built on the basis of syntactic hypotheses comes up against a range of problems. This then raises the question of whether postulating this is a prerequisite for the way in which Sperber & Wilson view the interpretation process, and a consequence of Relevance theory.

Sperber & Wilson support their claim that syntactic hypotheses are built during the process of interpretation by referring to Johnson-Laird (1983). What Johnson-Laird actually says about syntactic hypothesis formation is the following:

> *"There are in principle several types of prediction that a parser might make. It could predict that the next constituent will be of a particular category. (...) It could predict that a particular constituent must definitely occur at SOME later point in the sentence, though not necessarily as the next constituent. The occurrence of* the *predicts a subsequent noun though it may not be the next word, and the occurrence of a dislocated constituent predicts a subsequent 'hole' that corresponds to it. Finally, the parser could make either sort of prediction with respect to optional constituents. For example, given the occurrence of a verb that can be used transitively or intransitively, it could predict that the next constituent is optionally a noun phrase. The point about making predictions is to increase efficiency. If too many predictions are made, however, the system will collapse under its own processing load. It would thus be folly to design a system that made top-down predictions about, say, occurrences of conjunctions, or adverbs like* only *or any other constituent that is ubiquitous. Such predictions would have to be made after almost every word in a sentence and mostly fail to be fulfilled."* (Johnson-Laird, 1983, pp.320-321).

As Johnson-Laird points out, there are different types of prediction that a parser might make, <u>in principle</u>. However, this does not mean that the parser makes syntactic hypotheses in practice. Johnson-Laird goes on to propose a processing model in which some syntactic hypotheses are made. In the case of verbs, he proposes that the parser makes a hypothesis on the basis of the principle of Lexical Preference (Ford, Bresnan & Kaplan, 1982). As we saw in Chapter 2, the claim that the parser operates according to this principle is not borne out by the experimental evidence.

What we saw in the case of verbs, is that the experimental evidence shows that all subcategorization frames of a verb become available after the verb is recognized. However, the evidence does not show what the nature of these subcategorization frames is, whether these are representations of syntactic subcategorization, or representations of argument structure (of some sort). If syntactic subcategorization information becomes available, then building logical hypotheses on the basis of this runs into problems, as we saw above. However, this is not the only possibility. Consider, for example, the verb *put*. *Put* has the syntactic subcategorization frame, v[_ NP PP], as in (4.13):

4.13. Put it on the table.

On the view that anticipatory logical hypotheses are based on syntactic hypotheses, the occurrence of *put* would give rise to an extended number of logical hypotheses, because, as we saw above, a PP can map onto different logical variables. However, the PP following *put* expresses the logical category SOMEWHERE. Furthermore, as we saw in chapter 3, *put* can occur with an implicit argument, as in (4.14):

4.14. Why don't you put 'yours sincerely'?

If anticipatory logical hypotheses are based on anticipatory syntactic hypotheses, (4.13) and (4.14) predict that *put* can occur, at least, in the logical forms in (4.15):

4.15a. SOMEONE put SOMETHING SOMEWHERE.
b. SOMEONE put SOMETHING.

However, although (4.14) only has two overt arguments, we interpret it as expressing (4.15a) rather than (4.15b), as, for example, in (4.16):

4.16. Why don't you put 'yours sincerely' at the end of your letter?

The reason for this is that (4.15b) is not a possible logical form for *put*, because it is inherent in the meaning of *put* that *putting* involves three 'entities': you can't put something without putting it somewhere. As we saw above, Sperber & Wilson say that:

> *"... there is a clear sense in which the logical category labels correspond to, and are indeed semantic interpretations of, syntactic category labels of natural language (...)."* (op. cit., p.206).

However, example (4.14) shows us that logical category labels cannot just be semantic interpretations of syntactic category labels of natural language, because that would give rise to the logical form in (4.15b); rather, it seems that an utterance like (4.14) is an incomplete realization of the logical form in (4.15a), and it is by virtue of the addressee knowing that *put* has this logical form, that s/he is able to interpret (4.14) as (4.16). It seems then that what the addressee recovers on encountering *put*, is not syntactic subcategorization information, but a specification of what sort of arguments it must occur with.

Chomsky (1986) proposes that information of this sort is stored in the mental lexicon. He says that what the lexicon contains is:

> *"... for each lexical item, its (abstract) phonological form and whatever semantic properties are associated with it. Among these will be the 'selectional properties' of*

> *heads of constructions: nouns, verbs, adjectives and particles ... The entry for the word* hit, *for example, will specify that it takes a complement with the semantic role of recipient of action (patient), and that its subject has the semantic role of agent ... For the word* persuade, *the lexical entry will specify that it takes two complements, the target of the action (let us say with the general semantic role of goal) and a proposition, and that the phrase of which* persuade *is head assigns the role of agent to the subject. Let us call these properties 'semantic selection' (s-selection) ... Is it also necessary to specify in the lexicon properties of categorial selection (c-selection), for example, that* hit *takes an NP complement (*hit John*)? The latter specification seems redundant; if* hit *s-selects a patient, then this element will be an NP. If c-selection is redundant, in general, then the lexicon can be restricted to s-selection."* (Chomsky, 1986, p.86).

Sperber & Wilson assume that logical forms are structured strings of concepts, rather than natural language lexical items, so that if this ASSUMPTION is correct, it raises the question of how these s-selection frames relate to the logical forms that they map onto, for example, how semantic roles relate to conceptual categories.

There are a number of problems with this proposal. In the first place, if we assume that the lexical item *put* s-selects an agent, a theme and a goal, then we would expect that an utterance such as (4.14) is ruled out. Since (4.14) is a possible utterance, this means that *put* either has two s-selection frames, or one s-selection frame with an optional goal. But either of these possibilities entail that a sentence like (4.17) is well-formed, which we would not want to say:

4.17. ? John put the book.

Secondly, Chomsky's choice of semantic roles is problematic. On the one hand, he uses thematic roles such as 'agent' and 'patient', whose status in linguistic theory is not precisely defined (cf. Dowty, 1989; Jackendoff, 1983, 1987; Stowe, 1989); and on the other hand he uses a notion 'proposition', as expressing a semantic property. 'Proposition' is not a thematic role such as 'agent' or 'patient', which raises the question of how it relates to thematic roles. Furthermore, Chomsky uses 'proposition' as a variable over clauses and NPs of the appropriate type, namely those that receive a propositional interpretation, without specifying what the semantic property is that 'proposition' expresses.

In the third place, s-selection frames of this kind do not give us a unified picture of semantic properties. On Chomsky's proposal, s-selection frames only specify what complements an expression can

take. This disregards the fact that there also are semantic restrictions on what kind of adjuncts can occur with different expressions. Consider, for example, the utterances in (4.18), as opposed to (4.19):

18a. The girl from next door is clever.
b. The girl with the funny ears is clever.
c. The girl sent home from school is clever.
d. The girl sitting at the window is clever.
e. The girl I met yesterday is clever.

19. ?The girl at five o'clock is clever.

Whereas the sentences in (4.18) are all semantically well-formed, (4.19) appears ill-formed, unless we interpret *at five o'clock* as denoting a spatial position at which the girl is, rather than a time, for example, when (4.19) is uttered in the context of a group of girls standing in a circle. It seems then that s-selection frames should also account for what adjuncts an expression such as *girl* can take. However, extending Chomsky's proposal to do this, leads to a number of problems.

One could say that *girl* s-selects for SOURCE, as in (4.18a), and for PROPOSITION, as in (4.18c,d,e). However, there does not seem to be a thematic role which captures what is expressed by the modifier in (4.18b): *with the funny ears* is not a goal, benefactive, or instrument, but rather expresses a property that the girl has. It seems then that we not only need thematic roles and the notion 'proposition' to describe s-selection frames, but also a notion 'property'. However, the property in (4.18b) can also be ascribed to the girl in a proposition, as in (4.20):

4.20. The girl who has funny ears is clever.

It seems then that 'proposition' itself does not express a semantic property, but rather that the contents of a proposition can express a semantic property, which may be a different one in different propositions, as in (4.18c,d,e) and (4.20). Moreover, it is not clear what it means to say that the lexical item *girl* s-selects a source, a property, or a proposition. None of the modifiers in (4.18) express semantic properties which are associated with the lexical item *girl* as such. Rather communicators use these modifiers to help the addressee pick out the intended referent of the whole referring expression (cf. Osgood, 1971; Sridhar, 1988). This means that these modifiers do not

modify the lexical item *girl*, but rather constrain the possible referents of the concept 'girl', by expressing a distinguishing property.

On the Chomskyan view of language, LF is a level of the grammar, consisting of lexical items and natural language syntax. This has as a consequence that the mental lexicon is the only possible place in which s-selection properties (of whatever format) can be stored. However, Sperber & Wilson propose that logical forms are representations of an inner language of thought. Since anticipatory logical hypotheses are logical forms in various states of completion, they are stated in the language of thought, rather than in natural language. This has as a consequence, that logical hypotheses are hypotheses about what concepts can combine with to yield a well-formed formula, rather than hypotheses about what lexical items will follow. As we have seen, the proposal that these logical hypotheses are based on syntactic hypotheses cannot be maintained, because it is not syntactic properties that are at stake, but rather semantic selectional properties: as Chomsky (1986) points out, postulating s-selection frames may make syntactic subcategorization frames redundant. But postulating that these semantic selectional properties are properties of lexical items runs into a range of problems.

However, the language of thought hypothesis allows for a different view. Postulating that the mind computes structured conceptual representations entails that information about how these representations may be structured has to be stated somewhere. Sperber & Wilson propose that concepts have entries for different types of information. This allows for the proposal that one type of information that is stored under a concept is information concerning which conceptual categories the concept can combine with. In other words, we can view s-selection frames as specifying semantic selectional properties of concepts, rather than of lexical items. Since conceptual selection frames apply to logical forms rather than natural language, this entails that they are stored in the logical entry of a concept, rather than in the lexical entry.

If we assume that selection frames are specifications about the logical forms that a concept can appear in, then we can account for the problems that faced Chomsky's (1986) proposal above. As a first approximation[1], we can propose that in the case of *put* the addressee accesses the logical entry of the concept, which will give her/him the

s-selection frame which tells her/him what logical variables the concept has to combine with to yield a well-formed formula, i.e.

4.21. SOMEONE put SOMETHING SOMEWHERE.

The addressee can then use this selection frame as an anticipatory logical hypothesis. In the case of (4.14), repeated here, there is no linguistic realization of the logical variable SOMEWHERE:

4.14. Why don't you put 'yours sincerely'?

On the view that s-selection frames specify semantic selectional properties of lexical items, this led to the position that *put* has two s-selection frames. However, one of the central claims of Relevance theory is that the linguistic input often underdetermines the propositional form of an utterance. This means that we can maintain that *put* only has the logical selection frame in (4.21), which yields the incomplete logical form (4.22) for the utterance in (4.14):

4.22. Why don't you put 'yours sincerely' SOMEWHERE.

This incomplete logical form can then be completed into a propositional form, such as (4.16), in accordance with the principle of relevance.

4.16. Why don't you put 'yours sincerely' at the end of your letter?

Viewed in this way, logical selection frames not only specify what conceptual categories the concept must combine with to yield a well-formed conceptual representation, but they also specify what a concept can combine with to yield a complex concept. For example, the concept GIRL will have as a specification that it can combine with a PROPERTY to yield a complex concept, as in the examples in (4.18), repeated here:

4.18a. The girl from next door is clever.
b. The girl with the funny ears is clever.
c. The girl sent home from school is clever.
d. The girl sitting at the window is clever.
e. The girl I met yesterday is clever.

Logical s-selection frames then specify two things, in the first place they specify what a concept has to combine with to yield a well-formed formula, and secondly, they specify what a concept can combine with to yield a complex concept.

As we saw earlier, Sperber & Wilson (1986) say that the lexical entry of a concept contains information about the syntactic category, co-occurrence possibilities and phonological structure of the word

which is the natural counterpart of the concept. Postulating that s-selection frames are stored in the logical entry however, forces us to reconsider this view. Not only does it become superfluous to say that co-occurrence possibilities are contained in the (input part of the) mental lexicon, but, since the selection frame specifies the logical structures the concept can occur in, it also becomes superfluous to postulate that information about the syntactic category of the word associated with a particular concept is stored in the mental lexicon. Instead, all the addressee has to do is recognize the phonological form of a word; this phonological form maps onto a concept (or different concepts in the case of ambiguity), which gives access to the logical entry of that concept, from which the addressee can recover the logical selection frame of the concept, as illustrated in figure 1):

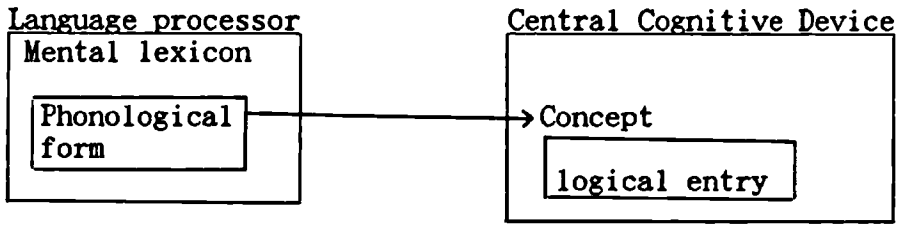


Figure 1): Recovering the logical selection frame.

It follows from this proposal that all linguistic expressions map onto concepts which have a semantic selectional specification. These semantic specifications consist of logical variables, which are conceptual categories. However, this raises the question of what conceptual categories there are, and how they combine to yield these logical s-selection frames.

4.3. The language of thought reconsidered.

Although Sperber & Wilson postulate that there may be a set of conceptual categories, which is part of basic human equipment, and as such part of the language of thought, they do not specify in detail what these conceptual categories are.

Jackendoff (1983) develops a theory of semantics which takes as its basic premise that meaning in natural language consists of information structures represented at the level of conceptual structure. He proposes that the major units of conceptual structure are conceptual constituents, which belong to a small set of major ontological categories. He argues that 'pragmatic anaphora' provide evidence for these different conceptual categories. As an example, he gives (4.23):

4.23. I bought that yesterday.

When someone points and simultaneously utters (4.23), the addressee has to pick out what is referred to by *that* from the immediate visual context, but s/he must also interpret the word *that*. Jackendoff argues that what *that* does is constrain the kind of entity that the addressee has to pick out:

> *"... the maximally simple NP "that" expresses a minimally specified [THING] in [4.23], and the visual field is the source of the remaining information in the intended message."* (Jackendoff, 1983, p.52).

Because interpreting (4.23) involves both linguistic and visual information, the interpretation of *that* must be an expression at the level of conceptual structure, which means that THING must be a conceptual category.

Jackendoff goes on to show that more categories than THING have to be distinguished as 'entities' at the conceptual level, because we can refer to them in the same way as we can refer to THINGS. As examples, he gives (amongst others):

4.24a. Your coat is here [*pointing*] and your hat is there [*pointing*].
PLACE

b. Can you do that [*pointing*]? ACTION

c. That [*pointing*] had better not happen again around here.
EVENT

d. You shuffle cards thus [*demonstrating*]. MANNER

e. The fish that got away was this [*demonstrating*] long. AMOUNT

In this way Jackendoff distinguishes a set of basic conceptual categories: THING, EVENT, STATE, ACTION, PLACE, DIRECTION, PATH, PROPERTY, AMOUNT, and MANNER. He does not claim that these categories exhaust the possibilities, but argues that for these categories linguistic and visual evidence are both present most prominently. Further categories may be SOUND, SMELL and TIME.

Claiming that these categories are basic does not mean that they cannot have any internal structure. For example, a PLACE may incorporate a THING, as in the PLACE *on the table*, which incorporates a THING, *the table*. However, Jackendoff argues that PLACES (and other categories) cannot be reduced to THINGS, because they individuate our perceptions in different ways: As an illustration of this, Jackendoff compares (4.25a) and (4.25b):

4.25a. Here is your coat, and there is your hat.

b. This is your coat, and that is your hat.

He says about these examples that:

> *"[4.25a]* locates *the coat and hat, while [4.25b]* <u>*identifies*</u> *them - two entirely different sorts of information."* (op. cit., p.50).

This means that THING does not have a privileged role among these categories, but rather that the conceptual categories "*characterize the distinction among major classes of entities that we act as though the world contains*" (op cit., p.51). In support of this he points out that the different conceptual categories can be referred to by using grammatical constructions which closely parallel constructions used to refer to THINGS. For example, each conceptual category can give rise to a Wh-question, with *what* to refer to a THING, *where* to refer to a PLACE or a PATH, *how* to refer to a MANNER or an AMOUNT, while ACTIONS give rise to *what did ... do?*, and EVENTS to *what happened?* Jackendoff points out that each of these questions can give rise to a reduced answer of the appropriate category. Furthermore, Jackendoff notes that we cannot just quantify over THINGS, but also over the other conceptual categories, apart from AMOUNT: we do not only get *something/everything*, but also *somewhere/everywhere* for PLACE and PATH, *do something/do everything* for ACTION, *some way/every way* for MANNER, etc.

Extra-linguistic support for some of these categories comes from observation of human perceptual development. Sridhar (1988) makes a number of generalizations about prelinguistic cognitive structures, based on the work of Bower (1974), Osgood (1980) and Greenfield & Smith (1976). Sridhar notes that by about 22 weeks of age, infants distinguish between 'entities' and 'relations', the states, actions or operations undergone by entities. Furthermore, they can distinguish between entities and their location or the movement associated with them. These distinctions correspond to Jackendoff's categories THING, for 'entities'; STATE and EVENT, for 'relations'; PLACE, for location; and MANNER, for movement. Sridhar notes that infants are particularly adept at distinguishing between human and nonhuman (animate or inanimate) entities, which provides some evidence for PROPERTY, and that infants distinguish animate entities as capable of voluntary action and acting upon objects, which corresponds to Jackendoff's category ACTION.

Jackendoff refers to observations of Kohler (1927) as evidence for the psychological reality of PATHS:

> *"[Kohler] points out that a sufficiently intelligent animal (e.g., a dog but not a chicken), confronted with food behind a transparent barrier, will "run in a smooth curve, without any interruption, out of the blind alley, round the fence to the new food..." The execution of such a smooth curve requires its being planned in advance - not as a finite sequence of points joined by straight lines, but as an entire path. ...Thus, if an animal can perform such an action as Kohler describes, it must be able to formulate concepts of spatial organization that fall under what we have called here the major ontological category of paths. In other words, not only language but the theory of action as well requires a notion of path, and it is pointless to try to eliminate it from language on grounds of parsimony.* (op. cit., pp.169–170).

As we saw above, the conceptual categories can have internal structure. In order to account for how the categories may be structured, Jackendoff proposes that there are a number of innate formation rules for conceptual structure. These formation rules consist of conceptual categories and functions, which map conceptual categories into different conceptual categories. For example, in *on the table*, *on* is a place-function that maps *the table*, a THING, into a PLACE. Some of the formation rules that Jackendoff proposes are given in (4.26):

4.26a. PLACE -> [$_{place}$ PLACE-FUNCTION (THING)]

b. PATH -> [$_{path}$ TO / FROM / TOWARD / AWAY-FROM / VIA (THING / PLACE)]

c. EVENT -> [$_{event}$ GO (THING, PATH)]
[$_{event}$ STAY (THING, PLACE)]

d. STATE -> [$_{state}$ BE (THING, PLACE)]
[$_{state}$ ORIENT (THING, PATH)]

The rule in (4.26a) expands a PLACE, as with *on the table*. (4.26b) expands a PATH, either by mapping a reference THING into a trajectory, as in *to the house*, or by mapping a reference PLACE into a trajectory, as in *from under the table*. (4.26c) expands an EVENT, either into an EVENT consisting of a THING moving along a PATH, where the function GO relates the THING and the PATH, as in *John went to the house*; or into an EVENT consisting of a THING and a PLACE, where the function STAY denotes stasis over a period of time, as in *John stayed in the kitchen.* (4.26d) expands a STATE, either into the location of a THING, using the function BE, as in *John is in the kitchen*; or to specify the orientation of a THING, using the function ORIENT, as in *The sign points toward New York.*

Concerning the relationship between natural language syntax and conceptual structure, Jackendoff argues that every major phrasal constituent in a natural language utterance corresponds to a conceptual constituent which is one of the conceptual categories. He says that:

> *"If a major phrasal constituent is used referentially, it corresponds to a projectable instance of a major ontological category. In other words, all major phrasal categories play the role assigned to NPs alone in first-order logic."* (op. cit., p.67)

Moreover, he argues that the lexical heads of a major phrasal constituent correspond to functions in conceptual structure. These functions can have zero or more argument places that must be filled in order to form a complete conceptual constituent. For example, in *The man went to the house*, *man* corresponds to a zero-place function which maps into the category THING, *to* corresponds to a one-place function which maps into the category PATH, and *went* corresponds to a two-place function which maps into the category EVENT.

Jackendoff points out that there is one exception to the correlation of major phrasal constituents with conceptual categories: VP is a non-major category which corresponds to the conceptual category ACTION. Jackendoff leaves it open whether a more general category PREDICATE should be distinguished. He argues that ACTIONS can be clearly individuated, while this does not seem to be the case for verb phrases which do not express ACTIONS. However, even in the case of 'non-actions' we can distinguish between the whole EVENT or STATE and the predication of the 'non-action'. Not only do we get (4.24b) to refer to an ACTION, and (4.24c) to refer to an EVENT, but also (4.24f) to refer to a 'non-action':

4.24b. Can you do that [*pointing*]? ACTION

c. That [*pointing*] had better not happen again around here. EVENT

f. That [*pointing*] happened to me once. 'non-action'

In (4.24f) *that* cannot refer to the whole EVENT, because the EVENT involves a different THING of whom the 'non-action' is predicated. ACTIONS give rise to *what did ... do?* and EVENTS to *what happened?* However, we can also have *what happened to you?* which does not question the whole event (as with *what happened?*), but rather the predication of the non-action. This can have a reduced answer, such as *Fell over and broke my leg.* It seems then that we not only need a category ACTION, but also a category which individuates 'non-actions'. One way of

realizing this is by proposing a general category PREDICATE which subsumes ACTION. This proposal is compatible with the assumption that an addressee constructs anticipatory logical hypotheses: on encountering a THING, the addressee recovers that the THING has to combine with something that is predicated of that THING to yield a well-formed formula. Only recovering the actual predication will tell the addressee what the nature of the predication involved is.

4.3.1. Decomposition versus holism.

Jackendoff's proposals concerning the representation of conceptual structure rest on the assumption that lexical meanings are decompositional, although they do not decompose into necessary and sufficient conditions. His main argument for this position is that on the view that meanings are unstructured monads, one cannot account for the creativity of concept formation and categorization. Jackendoff distinguishes between a representation of a projectable 'entity', i.e. a TOKEN, and a representation of a category, i.e. a TYPE. He argues that:

> *"... one can create new [TYPE] concepts at will. One of the simplest ways to do this is to construct, for an arbitrary [TOKEN]$_i$, a [TYPE] of THINGS LIKE [TOKEN]$_i$, where likeness can be determined along any arbitrary class of dimensions. For each of the indefinitely many [TOKENS] that one can construct in response to environmental stimulation, there are any number of such [TYPES]. These in turn can be used to categorize arbitrary [TOKENS]. (...) We (...) have reason to reject Fodor's (1975) theory that all possible [TYPES] are innately given as unanalyzed monads: a [TYPE] without internal structure cannot be compared with novel [TOKENS] to yield categorization judgments. Moreover, Fodor's theory entails that that there is only a finite number of [TYPES], since there is only a finite space in the brain for storing them all. ...But if one can generate new [TYPES] at will on the basis of given [TOKENS], then either the set of [TYPES] must be infinite, contra Fodor, or else the set of [TOKENS] must be finite and innate, a totally implausible conclusion."* (op. cit pp.82-83).

However, Relevance theory proposes that concepts give access to different types of information, and that the context in which the concept is used determines what subset of that information becomes available. This has as a consequence that 'the creativity of categorization' can be accounted for in terms of comparing subsets of information stored in logical and encyclopaedic entries of concepts, rather than by claiming that concepts are decomposed structures.

Jackendoff (1989) argues that the (holistic) meaning postulate account of meaning denies the possibility of generalizing over the inferential properties of different lexical items. As an example, he looks at the entailment relationship between the members of causative-noncausative pairs, such as in (4.27):

4.27a. x killed y -> y died
b. x lifted y -> y rose
c. x gave z to y -> y received x

Jackendoff points out that in a meaning postulate theory these inferences are totally unrelated. However, intuitively they follow a single pattern, which can be captured in a schema, such as in (4.28), where E stands for an Event:

4.28. x cause E to occur -> E occur

In order to be able to use a schema like (4.28), the meaning postulates for *kill*, *lift*, and *give* should be given like (4.29), rather than like (4.27):

4.29a. x kill y -> x cause [y die]
b. x lift y -> x cause [y rise]
c. x give z to y -> x cause [y receive z]

Jackendoff argues that if one adopts the meaning postulates in (4.29) then there is no difference between the meaning postulate and the decompositional approach. The meaning postulates in (4.29) are a notational variant of the analysis of causatives in a lexical decomposition theory: it is claimed that there is an element *cause* which is mentioned in the analysis of many lexical items, and which gives access to more general-purpose rules of inference.

However, Carston (1985) uses causative verbs to argue against the decompositional view, and in favour of meaning postulates. She points out that it has been shown (e.g. Fodor, 1981) that even for causative verbs only necessary conditions, but not sufficient conditions can be given. This means that one ends up with a system of partial definitions. This has as a consequence that most of the advantages of the decompositional approach are lost, such as predictions of synonymy and antonymy.

Carston argues that even if meanings can be decomposed, there still is a need for inference rules (i.e. meaning postulates) to account for entailments, such as those between 'X CAUSE P' and 'P' (what Jackendoff calls a 'schema', as in (4.28)). Furthermore, she argues that

relations which may hold among primitives in a decompositional system can only be stated in terms of meaning postulates, since primitives are not definable. This then means that the meaning postulate approach is a uniform approach, while the decompositional approach still has to incorporate inference rules. However, Jackendoff does not propose decomposition as an alternative to inference rules, but rather gives a place to both within his framework. The question then is how one can decide between the two proposals concerning the nature of concepts.

Pinker (1989) presents evidence from different sources that verb meanings, at least, seem to be decomposed. Pinker claims that Gentner (1981) and Gergely & Bever (1986) show that, compared to nouns, verbs are processed quite differently. Verbs are not remembered well verbatim; they do not survive intact in double translations (where one bilingual speaker translates a passage, and another bilingual speaker translates it back); and verbs do not survive intact in paraphrases of sentences. Moreover, children, in general, acquire verbs later than nouns, and tend to make mistakes in using verbs, which are attributable to incomplete or mislabeled semantic structures in many cases. Pinker shows that some argument structure errors that children make can only be explained if one assumes that children link argument structures to details of the verb's semantic structure:

> *"Say the child seeks verb V_1 which has meaning M_1, argument structure A_1, and stem S_1. Instead, his retrieval mechanism gives him stem S_2 from verb V_2, because of the similarity of its meaning M_2, with M_1. Now the question is: will the argument structure used by the child be A_2, because the stem is S_2, or A_1, because the meaning is M_1? Another way of putting it is, when a stem and a meaning part company, does the stem get its way in choosing the argument structure, or does the meaning? The empirical answer is that when A_1 and A_2 are different, we usually find A_1, the argument structure belonging to the target meaning, being used. Children say* Put Eva the yukky one first, *or* You put the pink one to me, *not* Put the yukky one into/onto Eva first. *Conversely, they say* Give some icecream in here, *not* Give some icecream to here. (...) *The view that argument structures are arbitrarily and conventionally paired with verbs directly and on a verb-by-verb basis, with no consistent contribution from lexical semantics other than specifying the number of arguments, would predict that an intruding verb should carry its own argument structure along with it; the fact that the child had a different meaning in mind would be irrelevant.* (Pinker, 1989, p.339).

Further evidence for the decomposition of verbs that Pinker presents, comes from the finding by Levin (1985), and Laughren, Levin & Rappaport (1986) that certain semantic elements (such as motion,

causation and contact) recur in different combinations which give rise to the range of different argument structure alternations (such as *I gave the book to Ann - I gave Ann the book*). Pinker argues that:

> *"More generally, there are strong universal tendencies for large sets of verbs within and across languages to make the same kinds of semantic distinctions (...) and for grammatical processes to attend to those distinctions."* (op. cit., p.170).

On the other hand, Carter (1976), Bybee (1985), and Talmy (1985) show that there are other semantic distinctions which verbs rarely make in any language.

However, although verbs in different languages make the same kinds of semantic distinctions, the way in which they are lexically realized can differ considerably. Pinker argues that one language may have a verb which expresses to walk in a particular manner, while in another language there is only a verb for walking itself, which has to combine with some other element such as an adverb to express that kind of walking. Moreover, some languages have a single verb for *making* and *doing*, while others distinguish them. On the view that verbs map onto monadic concepts, this would lead to an extreme version of the Sapir-Whorf hypothesis, while on the view that verbs meanings are decomposed structures this can be easily accounted for.

Furthermore, Pinker points out that there is a correlation between the aphasic syndrome called agrammatism and the use of verbs. Spontaneous speech of agrammatic aphasics is non-fluent, utterances are usually short, words like determiners, auxiliaries and prepositions are often omitted, and the range of syntactic structures used is restricted. However, agrammatic aphasics also turn out to have particular difficulty with verbs. Pinker says about their use of verbs that:

> *"[Agrammatic aphasics] make errors in inflecting them, have difficulty producing them, and often omit them entirely (Gleason, Goodglass, Obler, Green, Hyde, and Weintraub, 1980; Marin, Saffran, and Schwartz, 1976; Miceli, Mazzuchi, Menn, and Goodglass, 1983; Miceli, Silveri, Villa, and Carammaza, 1984). Since these deficits involve the use of verbs in sentences, they could reflect the difficulties in coordinating syntactic constraints with verbs' representation, rather than difficulties in representing or processing the verbs themselves. But Miceli et al. (1984) showed that verbs themselves suffer in agrammatism. They simply asked agrammatics to name objects and actions depicted in drawings; no sentence processing was required. Agrammatics had more difficulty naming actions than objects. This was not due to the*

> *intrinsic difficulty of the task; anomics - brain-injured patients with general difficulties in naming - showed the opposite pattern, and intact control subjects showed no difference. As Gentner notes, these findings suggest that verb meanings and syntactic rules share some of their neurological machinery."* (op.cit, p.172).

If these findings constitute evidence for decomposition, we must ask how the view that verb meanings are decomposed structures can be squared with the claim that verb meanings are not definable. Pinker argues that we can view verbs as consisting of universal, recurring, grammatically relevant meaning elements plus slots for bits of conceptual meaning idiosyncratic to the particular verb. He proposes that the complete meaning of a verb will be derived from three factors:

> *"(a) the information in the grammatically irrelevant conceptual slots; (b) the cognitive content of the various grammatically relevant elements and configurations (...), and (c) general principles of lexicalization (such as conventionality, genericness, and stereotypy) that dictate that when a semantic structure is lexicalized into a single word, this in and of itself can lead to emergent semantic properties. Thus a semantic structure translated into a paraphrase need not be exactly synonymous with the single word it is designed to represent."* (op. cit., p.168).

This proposal is not without problems. If lexicalization of a semantic structure as a single word gives rise to "*emergent semantic properties*", then one would like to have some account of how those properties are represented. An appeal to notions such as 'conventionality', 'genericness' and 'stereotypy' by itself does not constitute such an account.

4.3.2. Jackendoff's treatment of verbs.

Jackendoff (1983) shows how a small number of functions together with the basic conceptual categories can give us a unified treatment of the meaning of verbs of spacial location and motion. As we saw above, spatial sentences can be divided between those that express EVENTS and those that express STATES. EVENTS can expand into different sorts of EVENTS. In the first place, EVENTS can consist of a thing moving along a path, as in (4.30):

4.30. EVENT -> [event GO (THING, PATH)]

For example, *John ran to the house* refers to an event in which John traverses a path specified as being *to the house.* The verb *run* specifies both that John traverses a path and the manner in which he

does it (running). (4.30) then captures the similarity among such verbs as *fly, fall, walk, crawl, come* and *go.*

Secondly, an EVENT can consist of a thing staying at a place, as in (4.31):

4.31. EVENT -> [event STAY (THING, PLACE)]

For example, *Ann remained at home* refers to an event in which Ann stays at a place specified as *at home.* The function STAY then accounts for the similarity among such verbs as *stay* and *remain.*

STATES can also expand into different sorts of STATES. There are STATES that consist of a thing being in a place, as in (4.32):

4.32. STATE -> [state BE (THING, PLACE)]

An example of this is *The rug lay on the floor,* which refers to a state of the rug being in a certain place, i.e. *on the floor.* (4.32) then captures the similarity among such verbs as *be, stand, sit* and *live.* STATES can also consist of a thing pointing in a certain direction, for which Jackendoff uses the function ORIENT, as in (4.33):

4.33. STATE -> [state ORIENT (THING, PATH)]

For example, *The sign points to Philadelphia* expresses the orientation of *the sign,* and the direction in which it is oriented, *to Philadelphia.* (4.33) accounts for the similarity among verbs such as *point, aim* and *face.* Jackendoff distinguishes a third class of STATES, referred to by 'extent sentences', in which the subject is asserted to occupy the entire path at a single point in time. He captures this by introducing a function GO_{Ext}, as in (4.34):

4.34. STATE -> [state GO_{Ext} (THING, PATH)]

An example of this is *This road goes to London,* in which the road does not move, but occupies an entire path, specified by *to London,* at a single point in time. (4.34) accounts for such verbs as *extend, reach,* and *go.* Jackendoff notes that most verbs of extent can also be used as verbs of motion (as specified by (4.30)), which may give rise to ambiguities, as in *The giant reached to the ceiling,* which can be used to describe a movement by the giant, or the giant's extreme height. Jackendoff suggests that one explanation of this may be that GO and GO_{Ext} are not in fact different functions, but that the difference depends on whether GO is a function of an EVENT or a STATE.

EVENTS can incorporate a two-place function CAUSE, which relates a THING and an EVENT, or two EVENTS, as in (4.35):

4.35a. [event CAUSE (THING, EVENT)]

b. [event CAUSE (EVENT, EVENT)]

(4.35a) accounts for such examples as *John made us laugh*, while (4.35b) accounts for *John's blowing bubbles made us laugh.* EVENTS can also incorporate ACTIONS, where an ACTION corresponds to the syntactic category VP. Jackendoff (1983) proposes that ACTION will be incorporated in the representation. However, Jackendoff (1987) argues that ACTION is better represented on a separate action tier.

Jackendoff follows Gruber (1965) in assuming that the semantics of motion and location provide the basis for a range of semantic fields. Jackendoff restates Gruber's hypothesis as the 'Thematic Relations Hypothesis':

> *"In any semantic field of [EVENTS] and [STATES], the principal event-, state-, path-, and place-functions are a subset of those used for the analysis of spatial location and motion. Fields differ in only three possible ways:*
> *a. what sorts of entities may appear as theme;*
> *b. what sorts of entities may appear as reference objects;*
> *c. what kind of relation assumes the role played by location in the field of spatial expressions."*
> (Jackendoff, 1983, p.188).

Jackendoff argues that assuming the thematic relations hypothesis allows one to conceive of the mind as adapting existing structures to new purposes, such as for organizing concepts which lack perceptual counterparts.

Jackendoff goes on to discuss a number of semantic fields in terms of the thematic relations hypothesis, the temporal, possessional, identificational, circumstantial and existential fields:

Temporal field:
a. [EVENTS] and [STATES] appear as theme.
b. [TIMES] appear as reference object.
c. Time of occurrence plays the role of location.
(op. cit., p.189).

Jackendoff shows how proposing this field predicts the parallelism of temporal and spatial expressions, as in (4.36):

4.36a. The meeting is at 6:00. (BE).
We moved the meeting from Tuesday to Thursday. (GO)
Despite the weather, we kept the meeting at 6:00. (STAY)

b. The statue is in the park. (BE)
We moved the statue from the park to the zoo. (GO)
Despite the weather, we kept the statue on its pedestal. (STAY)

Alienable possession
a. [THINGS] appear as theme
b. [THINGS] appear as reference object.
c. Being alienably possessed plays the role of location; that is, "y has/possesses x" is the conceptual parallel to spatial "x is at y". (op. cit., p.192).

This proposal means that expressions such as *Beth has/possesses/owns the doll* will be represented as (4.37):

4.37. [State BEPoss ([DOLL], [Place ATPoss ([BETH])])]

Although this proposal may seem implausible, some support for it comes from the fact that some languages do not have a verb *have*, but instead use the verb *be*, as in Scottish Gaelic:

4.38. Tha botul aig an duine.
Is a bottle at the man. = The man has a bottle.

Furthermore, English has possessive *The book is mine*, and *The book belongs to Beth.*

Identificational field:
a. [THINGS] appear as theme.
b. [THING TYPES] and [PROPERTIES] appear as reference objects.
c. Being an instance of a category or having a property plays the role of location. (op. cit., p.194)

This field accounts for such examples as *John became a father* and *Ann is famous.* An example of this is (4.39):

4.39. Elise is a pianist.
[State BEIdent([Thing Token ELISE], [Place ATIdent ([Thing Type PIANIST])])]
(op. cit., p.194).

Again the analysis may seem implausible, but it is reflected in Scottish Gaelic, where we find (4.40):

4.40. Tha mi 'nam mhaighstir-sgoile.
Am I in my school-master. = I am a school-master.

Circumstantial field:
a. [THINGS] appear as theme.
b. [EVENTS] and [STATES] appear as reference objects.
c. "x is a character of y" plays the role of spatial "x is at y".
(op. cit., p.198).

This field accounts for such examples as *John is/started/stopped/kept playing football.*

Jackendoff describes a further 'pseudospace', which only has a single reference location:

Existential field:
a. [THINGS] and [STATES] can serve as theme.
b. There is one reference region, called [EX], expressed by "existence". (op. cit., p.202).

This field gives us expressions such as *Come into/be in/go out of existence*, and verbs such as *create, exist* and *destroy*.

These different semantic fields account for the different uses of *be*, as in (4.41):

4.41a. The book is on the table. (Spatial).
b. The meeting is at six o'clock. (Temporal).
c. The book is mine. (Possessive).
d. Ann is a teacher. (Identificational).
e. Ann is nice. (Identificational).
f. Ann is reading. (Circumstantial).

Jackendoff analyses *keep* as (4.42), and shows how the different semantic fields account for its uses, as in (4.43):

4.42. [Event CAUSE ([THING],[Event STAY ([THING],[PLACE])])]

4.43a. Sue kept the books on the shelf. (Spatial).
b. We kept the meeting at six o'clock. (Temporal).
c. Sue kept the book. (Possessive).
d. Sue kept John a happy man. (Identificational).
e. Sue kept John happy. (Identificational).
f. John kept reading. (Circumstantial).

Jackendoff's proposals then give us a treatment of (some) polysemy in language. Rather than having to claim that verbs like *go* and *keep* have different, though related, senses, this account shows that a unitary meaning gets different interpretations depending on which semantic field is at stake.

4.3.3. Pinker's treatment of verbs.

Pinker's (1989) treatment of verbs is motivated by his work on language acquisition. He addresses the question of how children learn which verbs have argument structure alteration and which don't. His starting point is the observation that many verbs allow argument structure alteration, as in (4.44-4.46):

4.44a. John gave a book to Ann.	give:	NP1 _ NP2 to NP3
b. John gave Ann a book.		NP1 _ NP3 NP2

4.45a. John passed the book to Ann. pass: NP1 _ NP2 to NP3
b. John passed Ann the book. NP1 _ NP3 NP2

4.46a. John told the story to Ann. tell: NP1 _ NP2 to NP3
b. John told Ann the story. NP1 _ NP3 NP2

At first sight, it might seem that the child could make a generalization that any verb with the argument structure NP1 _ NP2 to NP3, can also occur with the argument structure NP1 _ NP3 NP2. The problem that faces the child is that not all verbs with the prepositional argument structure can occur with both versions of the alteration:

4.47a. John donated a picture to the museum.
b. *John donated the museum a picture.

4.48a. John reported the accident to the police.
b. *John reported the police the accident. (Pinker, 1989, p.7).

The problem faced by the child is exacerbated by the fact that negative evidence is not available to the child: the child cannot conclude from the non-occurrence of sentences like (4.47b/4.48b) that these sentences are ungrammatical, because it may just be accidental that no-one has uttered them in the child's hearing.

The child is not only faced with this problem in relation to the dative alteration, but also in relation to the passive (4.49), the lexical causative alteration (4.50) and the locative alteration (4.51), (op. cit., p.8):

4.49a. John touched Fred.
Fred was touched by John. (also *hit, see, like, kick,* etc.)

b. John resembled Fred.
*Fred was resembled by John.

4.50a. The ball rolled.
John rolled the ball. (also *slide, melt, bounce, open, close,* etc.)

b. The baby cried.
*John cried the baby.

4.51a. Irv loaded eggs into the basket.
Irv loaded the basket with eggs. (also *spray, cram, splash, stuff,* etc.)

b. Irv poured water into the glass.
*Irv poured the glass with water.

Pinker argues that there are two sorts of constraints that govern argument structure alteration, morphological constraints and semantic constraints. Because the morphological constraints do not bear directly on my concerns I will leave these aside, and concentrate on the semantic constraints. Pinker points out that dativizable verbs share a semantic property, which he calls the 'possessor effect', which distinguishes them from undativizable verbs. This means that in the case of verbs which appear with *to*, the indirect object is not only the goal of the movement or transfer of the direct object, but also its possessor. In the case of verbs which appear with *for*, the indirect object is not only the beneficiary of the act, but also must come to possess the direct object as a result of the act. To illustrate this 'possessor effect', Pinker gives the following examples:

4.52a. John sent the package to the border/boarder.
John sent the boarder/*border the package.

b. Rebecca drove her car to Chicago.
*Rebecca drove Chicago her car.

c. Bob made/got/stirred/tasted the cake for Phil.
Bob made/got/*stirred/*tasted Phil the cake.

What we see then, for example, is that *send* does not allow alteration in the case of the indirect object *border*, because this denotes a location, which can be a goal, but not a possessor. In the case of *boarder* alteration is possible, because it is both a goal and a possessor.

Verbs which allow lexical causative alteration also share a semantic property, which Pinker calls the 'directness effect'. This means that intransitive verbs expressing an event allow the causative alteration if the event is caused by direct or physical contact, but not if the event is caused by an extended chain of causation, in which case the causation is expressed by a causal verb such as *make*, *cause* or *let*. This then can explain the difference between (4.50a) and (4.50b), repeated here:

4.50a. The ball rolled.
John rolled the ball. (also *slide*, *melt*, *bounce*, *open*, *close*, etc.)

b. The baby cried.
*John cried the baby.
John made the baby cry.

Moreover, as Pinker points out, it accounts for why we cannot have (4.53a), although (4.53b) is fine:

4.53a. *John broke the glass by startling the carpenter, who was installing it.

b. John made the glass break by startling the carpenter, who was installing it. (op. cit., p.49).

On the other hand, if the event is caused by direct contact, *break* does allow the causation alteration, as in (4.54):

4.54. John broke the glass by dropping it.

The semantic property underlying the locative alteration is what Pinker calls 'the holism effect'. This means that verbs denoting the transfer of some substance or set of objects into or onto a container or surface, allow the locative alteration if the action results in complete filling or depletion, but not if the action does not result in a complete filling or depletion, which accounts for the differences between (4.55) and (4.56), (op. cit., p.49-50).:

4.55a. Irvy loaded hay into the wagon.
Irvy sprayed water onto the flowers.
Irvy emptied water from the bucket.
Irvy drained mud from the pipes.

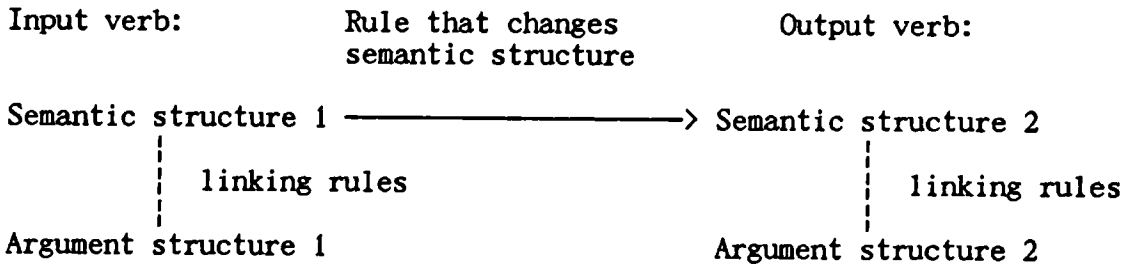
b. Irvy loaded the wagon with hay.
Irvy sprayed the flowers with water.
Irvy emptied the bucket of water.
Irvy drained the pipes of mud.

4.56a. Irvy threw the cat into the room.
Irvy pushed the car onto the road.
Irvy read a story from the book.
Irvy threw the ball from the porch.

b. *Irvy threw the room with the cat.
*Irvy pushed the road with the car.
*Irvy read the book of a story.
*Irvy threw the porch of a ball.

Pinker argues that previous attempts to account for how children learn which verbs allow alteration and which verbs don't (e.g. Mazurkewich & White, 1984; Pinker, 1984) failed, because of an unwarranted assumption. They assumed that although the syntactic argument structure of a verb could be transformed into a different argument structure (by some lexical rule), the semantic representation of the verb itself was basically unchanged by this operation. In other words, the new and old verb forms were taken to be synonymous. However, Pinker argues that when we look at the different alterations, it turns out that we do not just end up with the same verb having different argument structures, but rather that the rules underlying alterations act directly on the verb's meaning and change it into a different meaning. On this view, the semantic representation of a verb is changed and as a result its argument structure changes too. This change is brought about by what Pinker calls 'linking rules' (see fig. 2 below, op. cit., p.63):

fig. 2.



Pinker argues that the semantic change that underlies the dative alteration is a change from a predicate meaning 'to cause X to go to Y' into a second predicate, 'to cause Y to have X'. The way in which the verb meaning then changes is that whereas the first predicate focuses on the effect that the action has on a theme, the second predicate focuses on the effect the action has on the possessor. Because the rule which changes the semantic structure changes a goal (cause to go to Y) into a possessor (cause Y to have), it cannot apply when a goal cannot be converted into a possessor, as is the case with *send* when it has a goal such as *border*, as in (4.52a), repeated here:

4.52a. John sent a package to the border/boarder.
John sent the boarder/*border a package.

Similarly, causavization involves converting a predicate 'Y changes' into a predicate 'X causes Y to change'. When a verb denotes a change which is not directly causable, then the rule which converts

the first predicate into the second won't apply, because there is nothing to apply to.

Pinker proposes that locativization involves converting a predicate meaning 'to cause X to go into/onto Y' into a predicate meaning 'to cause Y to change state by means of putting X into or onto it'. Only verbs which have a means of expressing how a container or surface changes state because of the addition of something onto or into it, will be sensitive to this conversion.

Pinker calls these rules 'broad-range' rules. He goes on to show that although these rules are necessary for an account of argument structure alterations, they are not sufficient because there are negative exceptions to these rules. For example, although Ann can become the "possessor" of news because Sue told it to her, or shouted it to her, *Sue shouted Ann the news* is not possible, while *Sue told Ann the news* is fine. In order to account for cases like this, Pinker proposes that a second type of rule operates over alterations, "narrow-range rules". These rules range over specific properties of verbs. For example, the dative alteration occurring with verbs like *tell, show, ask,* but not with verbs like *shout, whisper, scream* is due to the fact that the primary function of the second type of verb is to focus on the manner in which a message is communicated: although they can be used to express successful communication, the verbs do not necessarily imply that successful communication has taken place. The first type of verb is not concerned with the manner in which the communication takes place (e.g. *telling* can be done by whispering or shouting), but with the particular kind of content that the speaker communicates, and the way in which the hearer interprets it, for example, *ask* involves a question, which requires an answer. 'Narrow range' rules operate over these finer distinctions among verbs.

Pinker argues that the semantic constraints do not just apply to rules converting one argument structure into another, but underlie verb meanings regardless of whether they have been derived from related verb meanings. This accounts for the (a) examples in (4.57)-(4.59), even though they are not derived from the (b) examples, which are ungrammatical (op. cit., pp.65-66):

4.57. Dative: to cause Y to have.

a. Alex bet Leon $600 that the Red Sox would lose.

b. *Alex bet $600 to Leon that the Red Sox would lose.

4.58. Causative: to cause Y to change.

a. John killed Mary.

b. *Mary killed (=died).

4.59. Locative: to cause Y to change state by means of putting X into or onto it.

a. I filled the glass with water.

b. *I filled water into the glass.

It turns out then that the argument structures that a verb has are not just syntactic variations but are the result of semantic properties of a verb meaning.

Pinker argues that different argument structures are associated with one or more 'thematic cores'. These 'thematic cores' are schematizations of types of events or relationships that define the cores of meaning of classes of possible verbs, conflation classes. As possible 'thematic cores' for some argument structure types he proposes:

Double-object:

X causes Y to have Z.

e.g. *Mary gave Ann a book.*

Transitive:

X acts on Y.

e.g. *Mary greeted Ann.*

Unergative Intransitive:

X acts.

e.g. *Mary laughed.*

Unaccusative Intransitive:

X is in a location or state or goes to a location or state.

e.g. *Mary arrived.*

Transitive with oblique containing *to*:

X causes Y to go to Z.

e.g. *Mary gave the book to Ann.*

Transitive with oblique containing *with*:

X causes Y to go into a state by causing Z to go to Y.

e.g. *Mary filled the glass with water.*

Intransitive with oblique containing *to*:

X goes to Y.

e.g. *Mary went to the lecture.*

These 'thematic cores' give us broad conflation classes, over which broad-range rules operate. Within these classes the specification of, for example, different manners, types of effect, and properties, define narrow conflation classes, over which narrow-range rules operate.

These 'thematic cores' can be realized in different semantic fields, as proposed by the 'thematic relations hypothesis' (Gruber, 1965; Jackendoff, 1983; discussed above), in which the semantic elements are given a specific interpretation. Moreover, different verbs within the same conflation class can be characterized as consisting of the thematic core of that conflation class together with idiosyncratic elements of meaning.

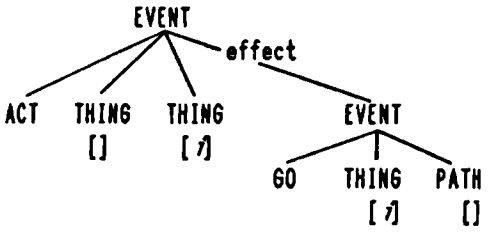
Pinker goes on to show how a fairly small vocabulary of semantic elements can be used to give explicit representations of a wide range of verb conflation classes. The semantic elements he uses are similar to those proposed by Jackendoff (1983), but are based on the cross-cultural survey of verb meanings carried out by Talmy (1985), which shows that there are recurring elements of verb meanings across languages. Pinker presents about fifty verb subclasses, embracing many hundreds of verbs.

4.3.4. Problems facing the decomposition view of verbs.

One of the differences between the representations proposed by Pinker, and those by Jackendoff (1983), is the way in which actions are conceived of. Jackendoff proposes that ACTIONS are EVENTS from which one argument is missing, the one corresponding to the ACTOR. Pinker, on the other hand, proposes that actional events involve a function ACT, which takes one or two arguments. A second difference is that whereas Jackendoff proposes CAUSE as a basic function, Pinker follows Talmy (1985, 1988) in analyzing causation into different ways in which an agonist and an antagonist can interact. These give rise to different causal relations, which can be represented by subordinating relations between a dyadic ACT (which has two arguments) and an EVENT or STATE, with the causal relation marked by a feature. the first argument of ACT can be equated with Talmy's 'antagonist', while the second argument can be equated with Talmy's 'agonist'. On the Jackendoff approach, this has as a result that, for example, the 'to-dative' is represented as in (4.60), while on the Pinker approach it is represented as in (4.61):

4.60. [Event[Thing ACTOR]$_i$, [Action CAUSE (i, [Event GO ([Thing], [Path])])]]

4.61.



On Jackendoff's analysis, we recognize that what an ACTOR does falls under the category ACTION, and differences among different actions are captured by what makes up the ACTION constituent. On Pinker's analysis the claim is that what we recognize is that someone acts on something, where the differences among different actions are captured by, for example, different causal relations. This means that on the analysis proposed by Pinker, we lose ACTION as a basic cognitive category. However, ACTION can be distinguished using Jackendoff's tests for cognitive categories, while Pinker's analysis is not supported by these tests.

A problem that faces both Jackendoff's and Pinker's approaches is the question of whether there is a principled way in which to decide how much detail goes into a semantic representation. For example, Pinker analyzes *eat* as in (4.62), while Jackendoff (1987) analyzes *drink* (which presumably belongs to the same conflation class, as in (4.63):

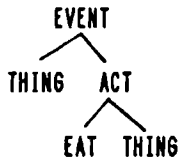
4.62.

4.63. [Event CAUSE ([Thing], [Event GO ([Thing LIQUID], [Path TO ([Place IN ([Thing MOUTH OF ([Thing] i)])])])])]

Jackendoff says of his analysis that it is an oversimplification. Presumably there would be more information about the trajectory that the liquid traverses, the drinker swallowing, etc. However, this representation has as a result that we could go into more and more detail, without there being a clear cut-off point. On Pinker's analysis of *eat*, no information at all is given of the trajectory that the eaten substance traverses. Pinker says of his analysis that the quoted symbol ("eating") "*serves as a pointer to some cognitive representation of the physical and geometric properties of the manner.*" (Pinker, 1989, p.193). Therefore some of the information that for Jackendoff is part of the semantic representation of the verb, is stored separately in Pinker's model.

Regarding the analysis into ACT THING THING, Pinker says that "*the second argument is the entity that is "affected", but only in the sense that it is involved in the act and its participation helps to define what kind of act it is; it does not necessarily change state or location.*" (op. cit., p.193). However, since the analysis does not show what causal relation there exists between the two entities apart from the fact that the second argument is the entity that is affected, this might as well be represented as (4.64):

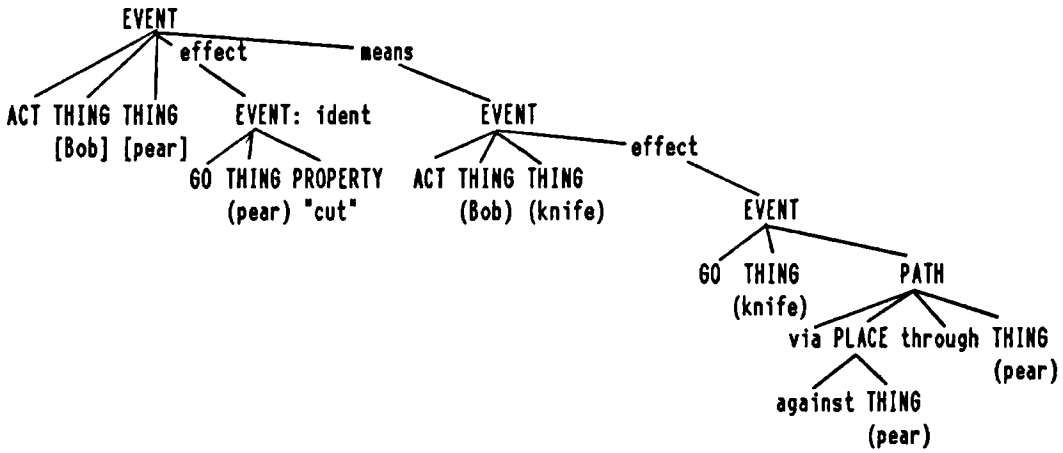
4.64.



On this analysis, the second argument is the entity affected because it is part of the act that the first argument carries out. Information about the 'physical and geometric properties' of the act can then be stored in the encyclopaedic entry of EAT. The advantage of this analysis over Pinker's analysis is that it keeps ACTION (here represented as ACT) as a cognitive category, in accordance with Jackendoff's analysis of cognitive categories.

Pinker proposes that the verb *cut* may be represented as in (4.65), where real names have been used for actors and patients:

4.65.



This can be paraphrased as 'Bob acts on a pear, causing the pear to become cut, by means of acting on a knife, causing the knife to go against and through the pear.' In this representation "cut" again is taken as a pointer to some cognitive representation of what it means to be 'cut'. However, Pinker partially represents what it means to be 'cut' in the representation of the verb *cut*, by specifying the means by which something becomes 'cut'. This analysis is motivated by his analysis of why verbs like *break* allow 'anticausavization', having both a transitive and an intransitive reading, while verbs like *cut* do not.

He argues that we can distinguish narrow conflation classes as well as broad conflation classes. On his view, *break* and *cut* belong to different narrow conflation classes, distinguishable by the fact that while *break* only has an 'effect' component in its semantic structure, *cut* has a 'motion' and a 'contact' component as well as an 'effect' component. Pinker proposes that the anticausative alteration applies to verbs which specify some effect, but only if they do not specify anything else but an effect.

Although this proposal distinguishes between verbs that do and verbs that do not allow 'anticausavization', the question is whether it is necessary to propose that these components are part of the semantic representation of the verb. An alternative could be that this sort of information is stored in the encyclopaedic entry of a concept. Some support for this view comes from experimental evidence of Lucas, Tanenhaus & Carlson (1990). Lucas et al. investigated what level of representation is accessed for antecedent assignments and instrument inferences. For instrument inferences, subjects were presented with isolated sentences containing verbs that strongly imply certain instruments, without these instruments being explicitly mentioned, and the same sentences with a lead-in sentences containing an explicitly mentioned instrument, as in (4.66):

4.66. (Lead-in: There was a broom in the closet next to the kitchen.)
John swept the floor every week/ on Saturday.

/ marks where target was presented for lexical decision.
Appropriate target: broom, inappropriate target: closet.

In order to control for task specific effects, these sentences were presented with different tasks, a lexical decision task, in which the subject had to decide whether the target is a word or a non-word, and a naming task, in which the subject had to name the target. The subjects heard the sentences over head-phones, while the target words were projected on a screen. Lucas et al. found that the presence of the verb implying the instrument did not speed up either the lexical decision task nor the naming task when the target was the instrument compared to the inappropriate target, when subjects were presented with the sentences in isolation. On the other hand, reaction times for the instrument targets were significantly shorter than for the inappropriate targets, in both tasks, when the sentences were presented with the lead-in sentence.

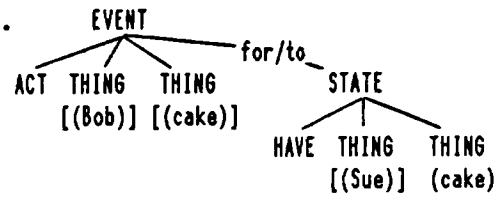
These findings cannot be explained if one accepts that a verb like *cut* is mentally represented as in (4.65). If a representation like (4.65) is recovered on hearing a verb like *cut*, then the information becomes available directly that the action is done by means of acting on some instrument, where that instrument is caused to behave in a certain way. On seeing a word like *broom*, after processing a verb like *sweep*, *broom* would fall into place as instrument within the representation of the verb, whereas there would not be any room within this representation for an unrelated word like *closet*. On this view then, one would expect that, even when a sentence containing a verb like *sweep* or *cut* is processed in isolation (without a lead-in sentence), reaction times would be speeded up in the case of instrument targets as compared to unrelated targets. However, Lucas et al. found that this is not the case.

On the view that information about instruments is not part of the semantic representation of the verb itself, but is stored in the encyclopaedic entry of the verb, we can explain the findings of Lucas et al. On this view, when one processes the sentence in isolation, the verb (and the other words) maps onto some conceptual representation, which gives access to encyclopaedic information; amongst other things, it gives access to assumptions about the action involving some instrument. However, these assumptions have no privileged status in comparison to other assumptions in the encyclopaedic entry. For example, since the second sentence in (4.66) focuses on John's habit of sweeping the floor every week, rather than on the means by which he does this, there is no reason to actually access the information that sweeping may involve a broom. This means that *broom* does not have any more cognitive significance for the subject than *closet*, so that reaction times do not differ for these words. When the subject processes the sentence with a lead-in sentence, the situation is different. *Broom* in the lead-in sentence gives access to encyclopaedic information, such as what brooms look like, that brooms are used for sweeping, etc. Again the assumption that brooms are used for sweeping does not have any privileged status compared to other assumptions in the encyclopaedic entry. However, on encountering *sweep* in the second sentence, this gives access to encyclopaedic information concerning sweeping. Since the assumption that brooms are used for sweeping is encyclopaedic information about both brooms and sweeping, this becomes highly accessible, so that the subject can draw the inference that John used the broom in the closet

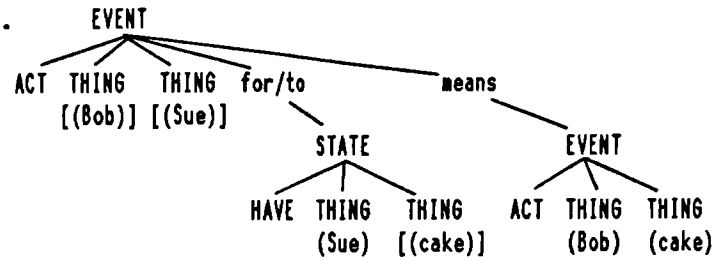
for sweeping the floor. In this situation, *broom* will be recognized quicker than *closet*, because it is mentally represented as part of the inference that the subject has just drawn.

A further problem that Pinker's proposal faces is the fact that it commits him to the claim that whenever a verb occurs with different argument structures this means that it has different meanings. As we saw above, in many cases of alteration this claim is indeed borne out, and accounts for which verbs will occur with particular alterations and which do not. However, there are cases where different argument structures do not seem to entail different verb meanings. This means that Pinker has to propose different meanings which do not seem to be borne out by how we understand these verbs. Cases that present a problem for Pinker's account are the 'for-datives'. Pinker proposes that underlying the alteration between, e.g., *Bob baked a cake for Sue*, and *Bob baked Sue a cake*, lies the broad range rule in (4.67), (op. cit., p.220):

4.67a.



4.67b.



Pinker says that (4.67a) can be paraphrased as 'Bob acted on a cake in order for Sue to have the cake', while (4.67b) can be paraphrased as 'Bob acted on Sue, in order for Sue to have a cake, by means of acting on the cake'.

The analysis in (4.67b) implies that we can have (4.68a) on a par with (4.68b), because Pinker analyzes both *bake* and *kiss* as a thing acting on a thing, where the second thing is the affected entity:

4.68a. John: What did you do to Sue?
Bob: ?I baked her a cake.

4.68b. John: What did you do to Sue?
Bob: I kissed her.

However, the exchange in (4.68a) is unacceptable, because *baking someone a cake* is doing something for someone, rather than to someone.

Pinker defends his analysis of 'for-datives' by referring to work by Green (1974):

> *"Green notes that the relation between the agent and the beneficiary is somewhat different in the double-object form than in the prepositional form, as is shown in (5.50). In the double-object form, the agent and the beneficiary must exist at the same time, and the agent must know that the beneficiary exists.*
> *(5.50) ...*
>
> *The American ambassador baked a cake for James I.*
> **The American ambassador baked James I a cake.*
>
> *I bought a ring for my wife in case I should decide to marry.*
> **I bought my wife a ring in case I should decide to marry.*
>
> *She's going to sing a song for her late lover.*
> **She's going to sing her late lover a song.*
>
> *Green proposes that the meaning of these double-object forms involve a component "X intends Y to have Z" and that the predicate "intend", unlike, say, "wish", "want", or "hope", has a presupposition that X believes Y and Z to exist. We could say that X must have Y in mind when entertaining his intention, and in fact that the X-Y relation is part of the definition of what X's intention is. That would be the interpretation of the representation "X acts on Y for Y to HAVE Z" in the lower half of [65b] and would motivate the difference between it and the prepositional form. The actual action would be a means to realizing this intention, though the intention itself needn't actually be realized.* (op. cit., p.221).

However, this proposal implies that the prepositional form does not carry the intention of X that Y comes to have Z, but this seems not to be true in an example like (4.69):

4.69. I knitted this jumper for Ann, but I never managed to give it to her.

By uttering (4.69) the speaker communicates that he intended Ann to have the jumper, but that for some reason this intention never actually was realized.

The relevance theory view of logical hypothesis formation and the distinction between foreground and background implications gives us an alternative account of why it seems that in the double-object form the relation between the agent and the beneficiary is somewhat different than in the prepositional form, without having to claim that this is due to the different forms expressing different meanings. Let us compare (4.70) and (4.71):

4.70. John knitted Ann a jumper.

4.71. John knitted a jumper for Ann.

When (4.70) is processed it will give rise to the following (simplified) correct logical hypotheses:

4.70a. John DID SOMETHING.
John knitted SOMEONE SOMETHING.
John knitted Ann SOMETHING.
John knitted Ann a jumper.

On the other hand, (4.71) will give rise to the correct logical hypotheses in (4.71a):

4.71a. John DID SOMETHING.
John knitted SOMETHING FOR SOMEONE.
John knitted a jumper FOR SOMEONE.
John knitted a jumper for Ann.

These lists give us the focal scales for the utterances in (4.70) and (4.71), as discussed above. Sperber & Wilson (1986) argue that the strongest presuppositional effects are carried by analytic implications of background implications. On this view, if the focus of (4.70) is *a jumper*, and the background is *John knitted Ann SOMETHING*, then the information that Ann exists will be analytically implied by the background, and an addressee who rejects this will be unable to access a context in which the utterance would be relevant. On the other hand, if the focus in (4.71) is on *Ann*, then the background is *John knitted a jumper for SOMEONE*, which does not analytically imply that Ann exists. Therefore, we do not have to claim that 'intention' carries a presupposition that the beneficiary exists. Both (4.70) and (4.71) can express that John knitted the jumper with the intention that someone comes to have it, where the existence of Ann is analytically implied in (4.70) because of the focal scale. This proposal has as a consequence that we do not have to postulate that verbs like *bake, knit, sew*, etc. have different meanings, one meaning expressing that the subject acts on a beneficiary, as Pinker is forced to do. What we see then is that there is a difference between verbs whose different argument structures express different meanings, and verbs which can occur with different argument structures which do not affect the meaning of the verb itself. One way in which we can account for this is to treat 'for-datives' as having one semantic representation, but that we can use this representation in different ways in constructing logical hypotheses.

A major problem which both Jackendoff's and Pinker's proposals face, is the fact that not all proposed semantic structures correspond in a transparent way to syntactic structures in natural language. Jackendoff proposes that there are correspondence rules between syntactic structure and conceptual structure. This proposal is taken up by Pinker, who suggests that there are linking rules which map open arguments in semantic structure onto syntactically distinguishable argument types, based on their position in the semantic structure. When we look at the conceptual structures proposed by Jackendoff, we see that although there is a general correspondence between the subject and direct object positions in a sentence and the first and second argument positions in conceptual structures, it turns out that this is not always the case. In particular, when we look at Jackendoff's proposal for the possessional field, we see that there is no direct correspondence between the syntactic positions in English sentences, and the positions in the conceptual counterparts of these sentences. Jackendoff proposes that verbs like *have, possess, own, receive* and *lose* are analyzed as in (4.72):

4.72a. Beth has/possesses/owns the doll.
[State BEPoss([DOLL],[Place ATPoss([BETH])])]

b. Beth received the doll.
[Event GOPoss([DOLL],[Path TOPoss([BETH])])]

c. Beth lost the doll.
[Event GOPoss([DOLL],[Path FROMPoss([BETH])])]

What we see in these examples is that Beth is the subject in the English sentences, but does not correspond to the first argument in the conceptual structure. Moreover, this difference between linguistic and conceptual structure does not occur with all verbs in English expressing possession, so that one cannot postulate that there is a systematic idiosyncratic mapping to express possession. For example, *belong* shows correspondence between linguistic and conceptual structure, as proposed by Jackendoff:

4.73. The doll belongs to Beth.
[State BEPoss([DOLL],[Place ATPoss([BETH])])]

One way out would be to say that verbs like the one in (4.72) have marked linking rules attached to them. However, Pinker argues against this move. One of the reasons he gives for this is that:

> *"... any theory that would depict 'have' as a highly marked exception going strongly against the thematic grain would leave it a mystery that 'have' is such a high-frequency, ubiquitous verb, and one that children acquire early and*

without any reversals of subject and object or intrusions of spatial prepositions ..." (op. cit., p.189).

In order to account for this problem, Pinker proposes that possession can be conceptualized in two ways: firstly, as 'possessional' PATHS and PLACES, as Jackendoff proposes, and secondly, as involving a primitive state type, which can be simply viewed as HAVE. In order to show the relation between these two ways of expressing possession, Pinker proposes an inference rule which says that "If X HAVE Y, then Y BE (place-function) X".

However, this move is not without problems. If the semantic representation of *have* is not motivated by our basic conceptual categories, but rather is acquired as a primitive function, and moreover if the relation between HAVE and possessional BE is expressed by an inference rule, then what we end up with for HAVE is a picture indistinguishable from the meaning postulate view. If we acquire HAVE in this way, then the question arises what the motivation is for saying that other verbs are not primitive functions with relations amongst them expressed by inference rule, but rather that they decompose into primitive components.

What we see then is that Jackendoff's and Pinker's approaches come up against a range of problems. However, Jackendoff's and Pinker's proposals concerning the semantic representation of verbs actually consist of two claims. A closer look reveals that these problems primarily concern the claim that verbs are semantically decomposed structures. As we saw above, there does not seem to be a principled way in which to determine how much detail goes into the decomposed structure, and, as we saw with verbs like *cut*, the proposed structure is not supported by the experimental evidence.

However, the claim that verbs decompose can be separated from the claim that the arguments a verb occurs with are an integral part of its meaning. This claim means that we cannot view a verb such as *put* as having a meaning PUT, which happens to occur with a subcategorization frame [_ NP PP]. Rather, *put* occurs with two THINGS and a PATH (incorporating a PLACE) because it is inherent in an act of *putting* that it involves these entities, so that they will be part of the semantic representation of the verb.

This way of viewing verb meanings gives us a basis for an account of argument structure alterations, and of how children learn which verbs do and do not allow alterations. The question then is whether, in order to give a full account, we also need to adopt the proposal

that the verbal part of the semantic representations is decomposed, and indeed whether decomposition necessarily follows from the view that there is a set of basic conceptual categories, as Jackendoff seems to suggest.

4.3.5. Structured verb meanings without decomposition.

At the heart of Pinker's and Jackendoff's proposals lies the conflation class hypothesis, the hypothesis that classes of verbs are organized around 'thematic cores'. Proposing these 'thematic cores' can account for the findings that there are strong universal tendencies for sets of verbs to make the same kinds of semantic distinctions, and that it is certain semantic elements that recur in different combinations which give rise to the range of different argument structure alterations, because it is these semantic elements that make up the 'thematic cores' of the different conflation classes. Pinker and Jackendoff go one step further in proposing that these 'thematic cores' are part of the conceptual structure of the individual verbs, while the differences among verbs of the same conflation class are shown by idiosyncratic conceptual slots. In other words, verbs are represented as decomposed structures, whose components consist of basic semantic elements and idiosyncratic conceptual slots.

However, a different way of viewing these conflation classes is to see them as types of states and events, where individual verbs are instantiations of the type, without this implying that the representation of the type is incorporated in the semantic representation of the instantiation. Pinker argues against this second view on the grounds that it does not give us an explanation of why particular semantic differences among verbs have predictable syntactic consequences. He argues that on this view:

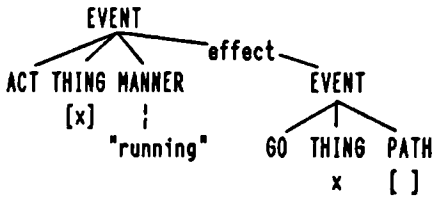
> *"In principle, any culturally salient distinction could be used as a dimension or feature helping to define similarity, and the syntax could reflect those similarity clusterings. This is another way of saying that from the point of view of grammar, verb meanings are not constrained at all."* (Pinker, 1989, p.166).

Pinker says that, on this view, deciding whether a verb like *cut* expresses a causative relation would be a similar process to deciding whether a dog is an animal and would depend on a person's real-world knowledge of causation. However, there are some problems with this argument. If verb conflation classes are organized around 'thematic cores', then these 'thematic cores' constrain class membership whether

or not their representations are part of the representations of individual verbs: unlike a word like *dog*, which by itself does not give any information to help a child decide that it's an animal, verbs occur with arguments which are compatible or incompatible with different 'thematic cores', so that without real-world knowledge possible conflation class membership is constrained. For example, a verb which occurs with three arguments is not compatible with a thematic core containing one argument.[2] Furthermore, the nature of the arguments involved can help the child decide what kind of verb is at stake. For example, a child who learns that TO involves a THING going to a PLACE can infer that when a verb occurs with *to* (such as *walk, drive, give*, etc.), the verb entails a THING going along a PATH to a PLACE. This need not necessarily be specified in the semantic representation of the verb, but can be stored in the logical entry of the concept. The inference itself helps the child decide on conflation class membership.

This raises the question of whether we need decomposition for an explanation of why different verbs behave as they do. Let us look at motion verbs such as *run, walk, swim*, etc. Jackendoff proposes that motion verbs specify that a thing traverses a path, where the distinction among different manners of motion is marked in a 'manner' slot, which gives access to conceptual information concerning the particular manner, e.g. running. Pinker points out that for verbs like *run* it is difficult to decide on conceptual grounds whether they should be represented as 'to run, with the effect of motion along a path', or as 'to move along a path, by means of a running action' (cf. Talmy, 1985). However, Pinker proposes that a verb like *run*, as in *John ran to the store* should be analyzed as an act in a particular manner with the effect of motion along a path, as in (4.74), where "running" gives access to conceptual information concerning running:

4.74.



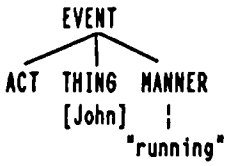
Pinker argues that this analysis is justified on linguistic grounds, because it helps to differentiate verbs of voluntary motion (e.g. *run*) from verbs of physical motion (e.g. *move*). However, Jackendoff (1987) shows how his analysis can also differentiate between these verbs, so

that again there is no principled way in which to choose betweent the two analyses.

When we take a closer look at verbs like *run, walk*, etc., it turns out that they can be used in different ways3. On the one hand, they can specify the manner in which someone gets somewhere, as in *John ran to the store*, the reading that Pinker's and Jackendoff's analyses apply to. On the other hand, they can focus on the activity itself, without implying that the actor is going somewhere, as in *John ran* or *John ran for an hour every day.* That this is a real difference between the uses of these verbs is borne out by the fact that the two uses of verbs like *run* show different syntactic behaviour in, e.g., Dutch. In Dutch, the perfect can be formed with either the auxiliary *zijn* (be) or the auxiliary *hebben* (have). *Hebben* is used with activity verbs such as Dutch *read, write, work*, and static verbs such as Dutch *rest, sleep, glow.* *Zijn* is used with mutative verbs, such as Dutch *die, wake up, melt*, etc. When we look at motion verbs, it turns out that when they are used to focus on the activity itself, the perfect has to be formed with *hebben*, while *zijn* has to be used when one wants to communicate that the activity was used to go along a path, going somewhere (e.g., Rijpma & Schuringa, 1978).

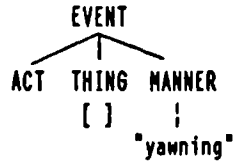
Because Pinker assumes that different argument structures always give rise to different semantic representations, he proposes that verbs like *run* occur with two representations. Although he does not actually give a representation for *run* as in *John ran*, it is implicit in his proposals that this would focus on the activity of running, as in (4.75), in which "running" again gives access to conceptual information concerning running:

4.75.



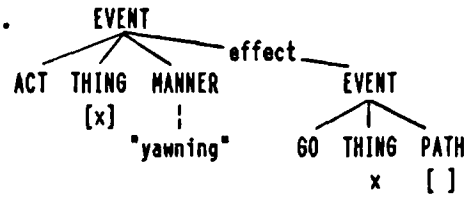
Pinker proposes that different semantic structures are derived from eachother by rules. This means that a child who has learnt that a verb like *run* has the semantic structures in (4.74) and (4.75), can apply the rules underlying the mappings from one semantic structure onto another to other motion verbs, and so learn that verbs like *swim, walk, crawl, skate*, etc. also have these semantic structures. However, this picture creates a problem. Pinker analyzes a verb like *yawn* as in (4.76), which is indistinguishable from (4.75):

4.76.



This means that one would expect that (4.76) could be transformed into (4.77a), by the same rule that transforms (4.75) into (4.74), but this is not the case, as shown by (4.77b):

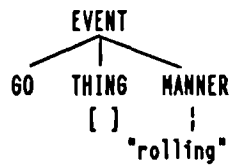
4.77a.



b. ? John yawned to the store.

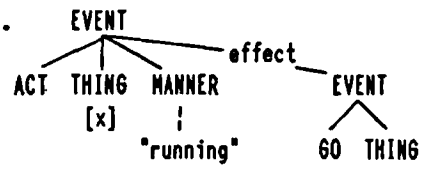
In order to account for the impossibility of (4.77) as opposed to (4.74), we would have to give narrow-range rules. The question then is what component of the structure this narrow-range rule should operate over. Although yawning and running both involve movement of some sort, the nature of the movements involved is quite different, and it seems that it is this difference which determines that *run* can occur with a PATH, and *yawn* cannot. Pinker proposes that there are different MANNERS, e.g. manners of motion, and manners of acting. It does not have to be explicitly stated in the representation which manner is involved, because the different manners are associated with different functions, for example, the function GO indicates that the manner involved is a manner of motion. To represent *roll*, as in *The ball rolled*, Pinker proposes the representation in (4.78):

4.78.



On a par with this representation it could be proposed that the representation of *run* in (4.75), should also incorporate the function GO, as in (4.79), so that the MANNER will be interpreted as a manner of motion:

4.79.



Pinker says about GO events without a PATH that:

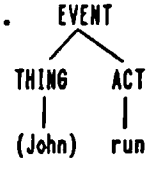
> *"...the MANNER information specifies the motion of the theme or parts of the theme relative to its own internal frame of reference (i.e., its prominent axes or center of mass), or with respect to its local environment, with no implication that there is any translation of the object as a whole with respect to the environment."* (op. cit., p.182).

However, in a *yawning* event the lips move relative to an internal frame of reference, just as the legs move relative to an internal frame of reference in a *running* event, so that a case can be made for incorporating the GO function in the representation of *yawn*, as well as in the representation of *run*. It seems then that we cannot explain the difference between verbs like *yawn* on the one hand, and *run* on the other, by looking for specific semantic components in the representations of the verbs. Instead, we have to turn to conceptual information, which is stored under the idiosyncratic manner slots. This tells us that the nature of the different motions involved is such that the one cannot be used to move along a path, whereas the other can, although it does not necessarily have to lead to movement along a path.

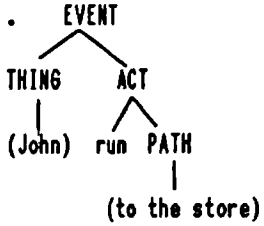
Decomposition is proposed as an explanation of why some verbs allow argument structure alterations and others do not. Since decomposition fails to differentiate between the above verbs, nothing is gained by postulating that motion verbs decompose, while doing so creates the problem that there is no principled way in which one can decide which proposed decomposed structure is the correct one.

We can capture the difference between the different uses of verbs like *run* by postulating that the arguments of the verb are an integral part of the semantic representation, without having to claim that the verbal part itself is decomposed: *run*, as in *John runs every day*, can be represented as in (4.80), in which case it focuses on the activity of running, while *run* as in *John ran to the store* can be represented as in (4.81), where the PATH slot is sufficient for the inference that the activity is used to go somewhere:

4.80.



4.81.



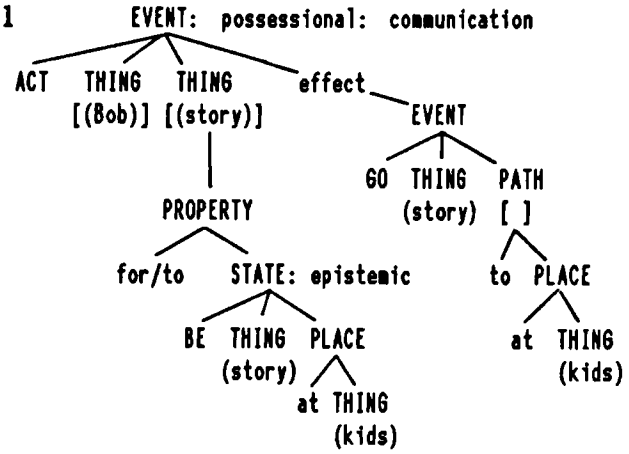
On this view, the mapping from (4.76) onto (4.77a) will be blocked by the conceptual information that activities like yawning cannot be used for locomotion.

When we look at the explanations that Pinker gives for the dative, locative and causative alterations, it turns out that decomposition is not crucial to these explanations.

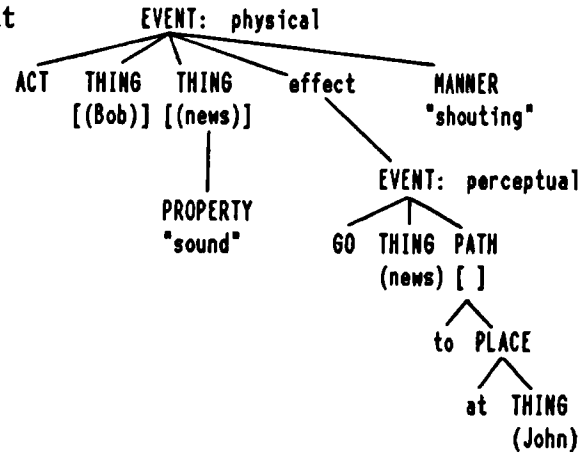
The broad-range rule underlying the dative alteration is the 'possessor effect': for the alteration to occur the indirect object must be not only the goal of the movement or transfer of the direct object but also its possessor. This means that the alteration depends on information about the indirect object, rather than on information about the verbal part of the representation.

In order to account for differences among dative verbs which depend on narrow-range rules, Pinker sets up detailed representations. For example, *tell*, which can alternate, is represented as (4.82), while *shout*, which cannot alternate, is represented as (4.83):

4.82. tell



4.83. shout



It is not clear whether these representations are necessary to explain the difference between *tell*-type verbs and *shout*-type verbs. When we look at Pinker's explanation of the difference, it turns out that this hinges on two things. In the first place, the THING that is told is

defined with respect to the speaker's intention that the hearer comes to know the THING, whereas the THING that is shouted is not defined in terms of an intended effect in the hearer (although shouting something to someone can imply successful communication, which presumably is inferred rather than given). What we are dealing with here are constraints on the interpretation of THING, which do not depend on *tell* or *shout* being decomposed; we could have the same constraints in a representation in which they are not decomposed. Secondly, Pinker argues that, unlike *telling*, *shouting* focuses on the behaviour of the communicator:

> *"...when shouting a question, what makes it shouting has nothing to do with a listener and can be defined in terms of the behaviour of the speaker alone."* (op. cit., p.118).

However, this means that what distinguishes *shouting* from *telling* depends on the conceptual information that we have about what it means for someone to shout, which again does not depend on whether *shout* is decomposed or not.

The broad-range rule underlying the locative alteration is the 'holism effect', i.e. verbs denoting the transfer of some substance or set of objects into or onto a container or surface, allow the locative alteration if the action results in complete filling or depletion, but not if the action does not result in complete filling or depletion. The broad-range rule underlying the causative alteration is the 'directness effect', i.e. the causative alteration is allowed if the event is caused by direct or physical contact, but not if the event is caused by an extended chain of causation.

Pinker points out that these effects follow from more general constraints on the interpretation of the affected entity, i.e. the direct object, regardless in what construction it appears. The holism effect follows from a general holism constraint which specifies that the affected entity must be completely affected. This constraint applies not only to locatives, but also to the (a) examples in (4.84), as opposed to the (b) examples:

4.84.a. John drank the glass of beer.
Beth climbed the mountain.
Bill painted the door.
Gary wrote many TV shows.

b. John drank from the glass of beer.
Beth climbed up the mountain.

Bill painted on the door.
Gary wrote for many TV shows. (op. cit., p.67).

In the (a) examples, the action affects the whole referent of the argument, i.e. all the beer was drunk, the entire height of the mountain was climbed, the whole door was painted, and the TV shows were written in their entirety by Gary.
The directness effect follows from a general directness constraint which specifies that what the agent did had an immediate impact on the affected entity (i.e. the direct object). This constraint applies not only to the causative alteration, but also to the (a) examples in (4.85), as opposed to the (b) examples:

4.85.a. Sally slapped/hit/kicked Mary.
Squeaky Fromme shot Ford.

b. Sally slapped/hit/kicked at Mary.
Squeaky Fromme shot at Ford.

In the (a) examples Sally landed a direct blow on Mary as intended, and Squeaky's shooting had a direct impact on Ford.

When we look at the causative alteration, it turns out that there are in fact verbs, which do not behave as one would expect on a decomposition view: although they describe the same event with or without causation, and although the causation involved is direct, the inchoative intransitive and the causative transitive cannot be expressed by the same verb. These are verbs like *kill/die*, *take/go*, and *raise/rise*. On the view that, for example, *die* decomposes into something like 'thing go out of existence', one would expect that when direct causation is involved one would be able to say *John died Bill*; or vice versa, if *kill* decomposes into something like 'thing causes thing go out of existence', where the causation involved is direct, one would expect that 'thing go out of existence' could be realized as *Someone killed* (=*died*). However, this is not the case. To account for this, Pinker proposes that there are no narrow-range lexical rules that map between these forms. He says about this that:

> *"Intuitively, the rules governing stem-sharing reflect how much the language lets you bend or enrich a verb's meaning before it has to be treated as a completely different verb. In effect, the lexicon groups some kinds of events together as exemplars of the same kind, to be expressed by a single verb, and differentiates other kinds of events. If John kills Bill, is that just causing him to die, or is there something unique about the act of killing that makes it different from the sum of its parts of causing and dying?*

English provides one kind of answer to this question."
(op. cit., p.134).

Decomposition is invoked to explain when argument structure alteration is possible, but if the decomposition of verbs like *kill* does not give us such an explanation, then again we have no justification for decomposition. If we have to propose that there is more to the meaning of these verbs than their decomposed structures, then the decomposed structure cannot be the semantic representation of the verb, and it is unclear what it does represent. It could be argued that there is a conceptual slot in the representation of *kill* which gives access to information about what makes an act qualify as a *killing* act. However, none of the conceptual constituents that Pinker proposes seems to capture what kind of slot this could be: an act of *killing* is not dependent on a particular MANNER or PROPERTY.

Similarly, when we look at Jackendoff's proposals, it turns out that what is crucial to his treatment of the polysemy of verbs like *keep* is not that *keep* is decomposed, but rather that the arguments that it takes are interpreted in different semantic fields. As we saw above, the analysis of *keep* (as in (4.42)) stays constant, while the different interpretations we get are due to us interpreting the arguments in different semantic fields, as in (4.43):

4.42. [Event CAUSE ([THING],[Event STAY ([THING],[PLACE])])]

4.43a. Sue kept the books on the shelf. (Spatial).
b. We kept the meeting at six o'clock. (Temporal).
c. Sue kept the book. (Possessive).
d. Sue kept John a happy man. (Identificational).
e. Sue kept John happy. (Identificational).
f. John kept reading. (Circumstantial).

The analysis of *keep* does not contribute anything more than monadic *keep* would. This means that we can retain the 'thematic relations hypothesis' without this committing us to decomposition.

When we look at the evidence that Pinker cites in support of decomposition (see section 4.2.1.), it turns out that this is compatible with the view that arguments are part of the semantic representations of verbs, with or without decomposition. For example, Pinker says that some argument structure errors children make can only be explained if one assumes that children link argument structures to details of the verb's semantic structure. This seems too strong; the findings can be explained if one assumes that children view argument

structures as part of the semantic representation of the verb, without this entailing that the verbs are decomposed.

Pinker argues that decomposition is supported by the fact that the same kinds of semantic distinctions may be lexically realized differently in different languages. For example, one language may have a verb which expresses 'to walk in a particular manner', while another language may use some other element such as an adverb to express that kind of walking. Pinker argues that on the view that verbs map onto monadic concepts, this would lead to an extreme version of the Sapir-Whorf hypothesis, but that it would be easily accounted for on the decomposition view.

However, accounting for this does not depend on adopting the decomposition view. Pinker's explanation is based on the assumption that verbs are organized in conflation classes around 'thematic cores'. These 'thematic cores' can account for the similarity in semantic distinctions across languages, while languages may differ as to what specific instantiations of these 'thematic cores' are lexically realized as verbs. But as we saw above, the view that individual verbs are instantiations of 'thematic cores' does not necessarily entail that the representations of these 'thematic cores' are part of the representations of the individual verbs. An alternative is that information concerning conflation class membership is stored as an inference rule in the logical entry of a concept. On this view the shared 'thematic cores' can still account for similarity in semantic distinctions across languages, while language specific influences can account for whether a particular instantiation of a 'thematic core' (such as walking in a particular manner) is individuated as a concept, and lexically realized in a language.

Pinker also assumes that the finding that some aphasics have more difficulty naming actions than objects indicates that verb meanings decompose. However, this conclusion is not warranted by the findings, since they can be explained in many different ways without requiring decomposition.[4]

The view that arguments are part of the semantic representations of verbs does not commit us to the view that verbs decompose into basic components. Moreover, by viewing verbs themselves as functions without internal structure, we do not face the problems that the decomposition view encounters. This way of viewing the representation of verb meanings overcomes a problem that the holistic (meaning postulate) approach faces. On the holistic view of word meaning,

inference rules for verbs cannot be formulated only involving the verbs themselves, e.g. we can only infer Y DIES from KILL if the inference rule is given as: X KILL Y -> X CAUSE [Y DIE]. However, if the lexical item *kill* maps onto an unstructured concept KILL, then there is no explanation for where the X and Y come from, nor what they stand for. Carston (1985) proposes that:

> *"... X and Y are variables ranging over arbitrary stretches of conceptual material, and (...) X and Y are upward entailing environments."* (Carston, 1985, p.29).

However, if this were the case, an utterance such as *John has killed again* would give rise to an inference such as JOHN CAUSE [AGAIN DIE], or, on the view that interpreting the utterance involves recovering an implicit argument, it could give rise to an inference such as JOHN CAUSE [SOMEONE AGAIN DIE]. Carston notes in a footnote that:

> *"Defining these [variables] is a problem for all analyses and needs attention."* (op. cit., p.29).

On the view that arguments are an integral part of the semantic representation of the verb, this problem disappears, because the variables turn out to be the arguments of the verb.

A further advantage of this view is that it gives us a basis for an account of implicit arguments.

4.4. Implicit arguments.

Pinker proposes that all different argument structures that a verb can appear with represent different meanings of the verb. However, as we saw with 'for-datives' this view cannot be maintained. A further consequence of his proposal is that it fails to make a distinction between verbs such as *run*, whose different argument structures express different meanings, and verbs such as *eat* for which this is not the case. As we saw above, only when *run* occurs with a PATH, does it necessarily imply movement along a path; on the other hand, it is intrinsic in the meaning of *eat* that something is eaten, whether this is lexically realized or not. We can account for this by proposing that *eat*, unlike *run*, only has one semantic representation, so that even when *eat* occurs without an overt second argument, this argument is implicit, because it is part of the semantic representation of the verb. Relevance theory then can account for how we interpret this implicit argument in different contexts: in accordance with the principle of relevance (c.f. Haegeman, 1987). As an example of how

the interpretation process works, consider Fillmore's (1986) examples in (4.86)-(4.88):

4.86. When my tongue was paralyzed I couldn't eat or drink.
4.87. We've already eaten.
4.88. I've tried to stop drinking.

Fillmore notes that whereas in (4.86) *eat* and *drink* simply designate the physical activities of eating stuff and drinking stuff, in (4.87) *eat* is used to mean something like *eat a meal*, and in (4.88) *drink* is interpreted as *drink alcoholic beverages*. How then do we get these different interpretations? On interpreting (4.86) the addressee recovers *eat* THING and *drink* THING, where the interpretation of the THINGS involved is constrained by what we know about eating, such as that eating involves something solid, and usually involves food of some sort, and that drinking involves something liquid. Because the activities are mentioned in the context of when the speakers tongue was paralyzed, assumptions about what is involved in eating and drinking as physical activities become easily accessible. This could give rise to contextual effects, such as that the speaker was physically uncomfortable, that she was hungry and thirsty at the time, that maybe she was fed intravenously, etc. This means that the recovery of SPEAKER COULD NOT EAT THING and SPEAKER COULD NOT DRINK THING may be relevant without any further enrichment, because the assumption that the speaker could not engage in these physical activities has some contextual effect.

To interpret (4.87), the addressee again recovers *eat* THING. However, in this case it is not enough to recover that the speaker and someone else have already been engaged in the physical activity of eating something, or of eating food, because we know that people perform this activity regularly, so that it will not give rise to any contextual effects. In order for the utterance to achieve relevance, the addressee has to assume that a significant instance of eating is referred to. Since meals are the main occasions of taking food for most people, MEAL is an easily accessible enrichment of THING. Moreover, this enrichment gives rise to contextual effects, such as that the speaker does not want to eat anything else, or that the speaker is ready to do something else.

To interpret (4.88), the addressee recovers *drink* THING. Although the proposition that the speaker has tried to stop drinking any liquid completely may give rise to contextual effects such as that the speaker

has tried to commit suicide, in the absence of a context which supports this interpretation, it will be ruled out because of our assumption that in order to live we have to drink. This means that in order for the utterance to achieve relevance THING has to be enriched. The concept of drinking gives access to assumptions about drinking things, such as the assumption that we drink liquids for sustenance, that we drink alcoholic liquids for pleasure and/or intoxication, and that drinking too much alcohol is bad for us. If the interpretation of THING as 'any liquid' is ruled out, the only interpretation that achieves relevance, will be the 'alcoholic drink' interpretation, because it gives rise to contextual effects such as that the speaker has been drinking too much alcohol, that s/he perceives that as a problem, that s/he is addicted to it etc.

Relevance theory then can account for how implicit arguments are interpreted. However, this is not all that needs to be said about implicit arguments: As we saw in section (4.1.2), although *Why don't you put 'yours sincerely'?* is perfectly acceptable, a sentence like *John put the book* is not, although we recover in both cases that a PLACE is involved. This means that we not only have to account for how implicit arguments are interpreted, but also for when we can use a verb with an implicit argument. Fillmore (1986) shows that verbs differ as to whether and under what circumstances they can occur with implicit arguments. There are verbs like *eat, drink, sew,* and *read,* whose implicit argument is indefinite. Fillmore claims that the implicit arguments of these verbs are obligatorily disjoint in reference with anything saliently present in the context, and therefore he refers to them as 'Indefinite null complements' (INC).

There are also verbs like *accept, object* and *wait* which can occur with an implicit argument, but only if the missing information can be immediately retrieved from the context. Because the referents of these implicit arguments have to be recoverable from the context, Fillmore refers to them as 'Definite null complements' (DNC).

The difference between these two types of verbs is illustrated by Ingham (1989), who compares *eat* to *follow* in the following examples:

4.89a. *John brought the sandwiches but Ann didn't eat - she ate the cakes instead.

b. The guide left but the tourists didn't follow - they followed the courier instead.

In (4.89a) the implicit argument of *eat* can not refer to the sandwiches, but has to be interpreted as something like *anything*, while in (4.89b) the implicit argument of *follow* has to refer to the guide mentioned in the sentence.

Fillmore argues that we can not give a pragmatic explanation for when an argument may be left implicit with the second type of verb, because no matter how clear the pragmatic context, some arguments cannot be left implicit. For example, even if it is perfectly clear to the addressee that a particular door is in question, (4.90) cannot be used to refer to that door:

4.90. *Did you lock? (op. cit., p.98).

Fillmore argues that a semantic explanation for DNC verbs does not seem possible either, because semantically related groups of verbs do not display the same behaviour regarding whether or not they allow implicit arguments. Some examples that Fillmore gives in support of this are:

4.91.	She insisted.	*She required. *She demanded.
	I tried.	*I attempted.
	They concurred.	*They acknowledged.
	She found out.	*She discovered.
	I'm waiting.	*I'm awaiting.
	When did she leave?	*When did she vacate? *When did she abandon?
	I protest. I object.	*I oppose.

Fillmore goes on to show that for polysemous verbs, DNC may be restricted to particular senses. For example, when we talk about winning or losing a game, an election, or any competition, we can say *he won* or *she lost*; however, when we talk about a prize that was won, such as *the gold medal*, *the blue ribbon*, we cannot say *he won*, and when we talk about a wallet or key that was lost, we cannot say *she lost*. Some other examples that Fillmore gives are:

4.92.	They accepted my offer. They accepted.	They accepted my gift. *They accepted.
	I applied for the job. I applied.	They applied the bandage. *They applied.
	She arrived at the summit. She arrived.	She arrived at the answer. *She arrived.
	I forgot to fix it. I forgot.	I forgot my keys. *I forgot.

I heard that you resigned.	I heard the song.
I heard.	*I heard.
She left home.	She left the package.
She left.	*She left.
She opened the shop early.	She opened the envelope.
She opened early.	*She opened.

Fillmore concludes that although there seem to be some semantic commonalities underlying DNC phenomena (e.g. the semantic connections between *win* and *lose*), these phenomena are not explainable by semantic facts. He proposes that individual verbs, or, in the case of polysemous verbs, senses of verbs have to be represented as having certain of their arguments marked for omission, either definite or indefinite.

However, given our reanalysis of how verbs are represented, it turns out that Fillmore's conclusion is too pessimistic, and that a semantic/pragmatic explanation is possible.

When we consider verbs that appear with THINGS, it turns out that there is a general principle underlying whether the THING can be left implicit or not, so that we do not have to propose that individual verbs are marked for implicit THINGS. This principle is that a verb can only be used with an implicit THING if the interpretation of the THING is constrained by the rest of the utterance, or by assumptions made available by the interpretation of the rest of the utterance. This gives rise to different possibilities. The meaning of the verb may constrain the interpretation of the THING, for example, as we saw with *eat* and *drink* above. Also, the interpretation of a further constituent in a particular utterance may constrain the interpretation of the THING in that utterance. For example, compare (4.93a) and (4.93b):

4.93a. ?Paul gave to Ann.

b. Paul gave to Amnesty International.

In (4.93a) *to Ann* does not constrain what it is that Paul gave Ann. In (4.93b), on the other hand, *to Amnesty International* does put a constraint on what he gave: we know that Amnesty International is a charity, and that charities want money to do their work. This means that the *money* interpretation becomes easily accessible.

When neither the verb nor any other constituent in the utterance constrains the interpretation of THING, then it cannot be left implicit. Why would this be the case? Relevance theory provides the answer. According to relevance theory a (genuine) communicator tries

to be optimally relevant. This means that s/he intends the utterance to provide the addressee with adequate contextual effects for as little processing effort as possible. This has as a consequence that the communicator must choose the utterance which s/he thinks is optimally relevant. When the intended interpretation of an argument is not constrained by the rest of the utterance, then an utterance in which it is left implicit is not going to be the most relevant one that the speaker can choose, and therefore it will be ruled out. For example, consider a situation in which two people, John and Sue are discussing the popularity of a particular book. John wants to illustrate this by communicating that Paul gave the book in question to Ann. In principle, there are several utterances that John can choose from, e.g. (4.93a) and (4.94):

4.93a. Paul gave to Ann.
4.94. Paul gave it to Ann.

By uttering (4.93a), John merely communicates that PAUL GAVE THING TO ANN. By inserting *it* in (4.94), John communicates that the referent of THING is retrievable from the immediate context, thereby constraining the interpretation of THING to the thing that they are discussing, i.e. the book. This means that by uttering (4.94) John saves Sue processing effort by guiding her to the intended interpretation, so that (4.94) rather than (4.93a) is optimally relevant. Moreover, by uttering (4.93a), John would communicate that (4.93a) is the most relevant utterance that he could have used to communicate the assumption(s) he wants to communicate. In (4.93a) there is no explicit constraint on the interpretation of THING, so that in principle it could refer to any THING that is manifest to Sue (such as the objects surrounding her). But by uttering (4.93a) John makes explicit that the THING was given to Ann, which therefore could encourage Sue to find a connection between Ann and the thing given, and thereby to conclude that John has changed the subject.

Relevance theory in fact predicts when a THING can be left implicit: when the communicator chooses an utterance from a range of possible utterances s/he chooses the optimally relevant one, which will be the one which gives the addressee adequate contextual effects for as little processing effort as possible. When the interpretation of a THING is constrained by the rest of the utterance, or by assumptions made available by the rest of the utterance, it can be left implicit because that will save the addressee recovering its phonological form;

when the interpretation is not constrained by the rest of the utterance, the communicator will have to put a constraint in, for example, by the use of a pronoun.

As we saw above, Fillmore makes a distinction between INC verbs, such as *eat, drink,* and *read,* and DNC verbs, such as *follow,* and *accept.* He says about this distinction that implicit arguments of INC verbs are obligatorily disjoint in reference with anything in the context, while implicit arguments of DNC verbs have to get their interpretation from the immediate context. This distinction is illustrated by Ingham's (1989) examples, repeated here:

4.89a. *John brought the sandwiches but Ann didn't eat - she ate the cakes instead.

b. The guide left but the tourists didn't follow - they followed the courier instead.

However, it turns out that the distinction that Fillmore draws is not valid, and that we can account for the behaviour of verbs like *eat* and *follow* without this distinction. In order to explain why (4.89a) is ill-formed and (4.89b) is well-formed we have to look at what kind of constraints the verbs involved put on the interpretation of THING. In the case of verbs like *eat, drink* and *read,* the verb puts a constraint on the type of THING that can be eaten, drunk or read, without putting any constraint on what instance of the THING is involved. This means that if one wants to communicate that a particular instance of a THING is at stake, one cannot just leave THING implicit, but has to specify what instance is meant, either by explicitly mentioning the thing or by putting an explicit constraint on the interpretation of THING, such as a pronoun. In the case of a verb like *follow,* there is no constraint on the type of THING that can be followed (in principle, one can follow anything), but the interpretation of THING is constrained by the fact that the THING has gone or is going somewhere before the THING that follows.

When we look at the interpretation of (4.89a), it turns out that the interpretation of THING is not "obligatorily disjoint" with *the sandwiches.* Since *eat* does not put a constraint on an instance of THING, the addressee cannot interpret THING as just referring to *the sandwiches*; however, (4.89a) communicates that Ann did not eat anything of the type that can be eaten, which means that *the sandwiches* are included in what she did not eat. Furthermore, since cakes are

also things that can be eaten, *the cakes* are also included in what Ann did not eat, so that (4.89a) is ill-formed.

Utterance (4.89b), on the other hand, communicates that the tourists did not follow a THING that had gone somewhere before them; since (4.89b) also communicates that the guide left, the most accessible interpretation of THING is that it refers to *the guide*. Because *follow* does not put a constraint on a particular type of THING, there is nothing to stop the tourists from following another THING, so that (4.89b) is fine. Moreover, because of the constraint on THING, we understand *the courier* as going somewhere before the tourists. This also explains why we cannot have (4.95a) if we want to communicate that John could not follow the lecture, but have to use (4.95b):

4.95a. ? John$_i$ went to the lecture on astronomy, but he$_i$ couldn't follow.

b. John$_i$ went to the lecture on astronomy, but he$_i$ couldn't follow it.

On interpreting (4.95a), we recover that John could not follow a THING that had gone somewhere before him. However, there is nothing in the context that has gone somewhere before John so that (4.95a) cannot be easily interpreted. On interpreting (4.95b) we again recover that John could not follow a THING that had gone somewhere before him. However, in (4.95b) the use of *it* constrains the interpretation of the referent of THING to *the lecture on astronomy*. Because a lecture on astronomy cannot physically go anywhere, this gives rise to a non-spatial interpretation, i.e. epistemic going and following.[5]

In the same way, we can account for when *approach* can occur with an implicit argument, and when it can't, as in (4.96):

4.96a. They approached me.
They approached.

b. We were approaching the town.
We were approaching.

c. They approached the solution.
*They approached. (op. cit., p.101)

Approach puts a constraint on the interpretation of its object in that it expresses a spatial relation between the THING approaching and the THING approached, such that the first THING is moving toward the second THING which is stationary. This means that the THING approached can be left implicit (as in (4.96a) and (4.96b)), when it is manifest what

the approaching THING is moving towards. In the case of interpreting (4.96c) with *the solution* left implicit, the addressee recovers that *They* are moving towards a stationary THING. However, even if the concept SOLUTION is easily accessible it does not represent a stationary thing that one can physically move towards, so that *They approached* does not make sense. When *the solution* is explicitly mentioned or referred to, it will give rise to a non-spatial interpretation, in this case epistemic approaching. When we look again at (4.96a) it turns out that when the argument is left implicit the utterance can only be interpreted as expressing a spatial approaching and not approaching as in 'making overtures to'. This can be explained along the same lines as the example in (4.96c). A consequence of this is that we do not have to postulate that the 'making overtures to' interpretation is a separate meaning of *approach*. When the spatial interpretation of *approach* is ruled out by the context, a non-spatial interpretation is made, but the specific interpretation that an addressee makes is dependent on the nature of the concept involved and the context, in accordance with the principle of relevance.

Fillmore shows that polysemous verbs may allow implicit arguments only with particular meanings and not with others. On the view that different verb meanings are represented as structured concepts incorporating the arguments that the verb appears with, we can account for this in a straightforward way. Fillmore goes on to conclude that different meanings of a verb will have to be individually marked as to whether they allow an implicit argument or not. However, it turns out that this is not necessary, and that in fact it makes the wrong predictions. For example, Fillmore points out that *win* can occur with a direct object that designates a contest or a prize, but that only on the first reading does it allow an implicit argument, i.e. we necessarily understand (4.97) as meaning that Ann won some competition, not a prize:

4.97. Ann won.

However, in (4.98) we understand Sue as having won a prize in the lottery, not as having won the contest, even though, according to Fillmore, this reading of *win* does not allow an implicit argument:

4.98. Sue was happy, because she won in the office lottery.

How then can we account for this? When we look at the different meanings of *win*, we see that, on the one hand, it can express that

someone won some competition, and on the other hand that someone won some prize. However, one doesn't just win a prize, but rather one wins a prize in a competition of some sort. This means that an utterance like (4.99a) already contains an implicit argument, such as in (4.99b):

4.99a. Ann won the silver medal.

b. Ann won the silver medal in the skating championships.

This in turn means that in order to get the 'prize' interpretation for (4.97) the addressee has to recover two implicit arguments, while in (4.98) *in the christmas lottery* rules out the competition interpretation. Moreover, whereas on the first reading of *win* the interpretation of the implicit argument is constrained by it being an instance of a competition, 'prize' does not put a constraint on what instance of the THING is involved, because a prize can be anything won in a competition. If a speaker wants to communicate that someone has won a particular instance of a prize, such as a silver or gold medal, s/he therefore will have to provide an explicit constraint on the interpretation of the direct object. By uttering (4.97) the speaker only provides a constraint on the 'competition' interpretation, and not on the 'prize' interpretation, so that, in accordance with the principle of relevance, this is the only interpretation that the speaker could have intended to communicate.

Fillmore argues that verbs like *win* and *lose* can only occur with an implicit argument if there is a contextually given competition of which the subject is the winner or loser, but this claim is too strong. For example, consider (4.100):

4.100. Martina Navratilova has won again.

Assumptions about Martina Navratilova being a tennis player, together with the constraint on the implicit argument of *win*, may give rise to the interpretation that Martina Navratilova has won an instance of some competitive tennis event. This interpretation may be relevant in its own right, without there having to be a particular contextually given competition, for example, in a discussion of the achievements of older sports people.

As further examples of verbs which have different meanings, one permitting an implicit argument, and the other not permitting an implicit argument, Fillmore gives *open* and *close*, as in (4.101) and (4.102):

4.101a. She opened/closed the drawer.

b. *She opened/closed.

4.102a. They opened/closed the shop early.

b. They opened/closed early.

Fillmore takes it for granted that (4.102b) contains an implicit argument. However, *open* and *close* also occur as ergative verbs, as in (4.103):

4.103. The shop opened/closed early.

and an alternative view is that in (4.102b) *open* and *close* are ergative, rather than transitive verbs with an implicit argument. On this view, what makes (4.102b) special is not that a different meaning of *open* and *close* is used, but rather that we interpret *they* as representing *the shop*. This analysis is supported by the fact that we often refer to shops, pubs, restaurants, etc. by means of referring to the people who run them, as in (4.104):

4.104a. Ann: Shall we go to the DIY shop in Chelmsford?

b. Sue: It's closed on Sundays.

c. Sue: They're closed on Sundays.

In (4.104c) there is no implicit argument, and *they* can only be interpreted as representing the DIY shop, by identifying it with the people who run it. That this is not a special use of *they* to refer to a third person singular thing, is shown in (4.105):

4.105. Pubowner: We are open seven days a week.

On this analysis we do not have to account for when *open* and *close* can occur with an implicit argument, and when not. Because there is no constraint on the instances of THINGS that can be opened and closed, the THING cannot be left implicit.

When we look at verbs which can occur with implicit arguments other than THINGS, it turns out that again an argument can only be left implicit, if its interpretation is constrained by the rest of the utterance, or by assumptions made available by the interpretation of the rest of the utterance. However, there is a difference between THINGS and non-THINGS such as PLACES and PATHS, in that the latter categories are individuated in relation to THINGS; i.e. a PLACE exists by virtue of a THING potentially or actually being located in it, while a PATH exists by virtue of a THING potentially or actually traversing it. This means that the interpretation of PLACES and PATHS is

inherently more constrained than the interpretation of THINGS, and consequently they can be left implicit more easily.

This can explain why we can have (4.106), (4.107) and (4.108b), but why (4.109) sounds awkward:

4.106. John put the book on the table.

4.107. Bill put the book down.

4.108a. Ann: I don't know how to finish this letter.

b. Sue: Why don't you put 'yours sincerely'?

4.109. ? Pat put the book.

Put occurs with a THING and a PATH incorporating a PLACE, but it does not constrain their interpretation. In (4.106) the PATH is left implicit. However, because (4.106) communicates that the book ends up on the table by John putting it there, the interpretation of PATH is constrained to 'some path between John and the top of the table'. Because recovering this may be relevant in its own right, the PATH can be left implicit. In (4.107) the PLACE is left implicit. However, the interpretation of PLACE is constrained by the PATH being down from Bill, which makes it a PLACE down from Bill. Again, recovering this may be relevant in its own right, so that the PLACE can be left implicit. In (4.109) both PATH and PLACE are left implicit. Since neither *Pat*, nor *the book* in (4.109) constrain the interpretation of where the book was put, it cannot be left implicit. In (4.108) again both PATH and PLACE are left implicit. However, *'yours sincerely'* gives access to the assumption that we only use *'yours sincerely'* to finish a letter, so that the interpretation of PLACE is constrained to AT END OF LETTER, and since Ann is writing a letter, the most accessible instance of LETTER, is the letter she is writing, which gives us the interpretation in (4.108c):

4.106c. Why don't you put 'yours sincerely' at the end of your letter?

When we look at verbs like *arrive* and *leave* (as in *She left home*), it turns out that they express relations between THINGS and PLACES. The PLACES involved are different for the different verbs: in the case of *arrive*, the PLACE is where the THING is/was going to before arriving, and in the case of *leave*, the PLACE is where the THING is before leaving. This means that for *arrive* the PLACE can only be left implicit if assumptions about where the THING is/was going are easily accessible, thereby constraining the interpretation; and for *leave* the PLACE can only be left implicit if assumptions about where the THING

is\was before leaving are easily accessible, thereby constraining the interpretation. This explains why we can't have something like (4.110a), while (4.110b) is fine:

4.110a. Ann was walking through the woods. *She arrived at six o'clock.

b. Ann walked to school. She arrived at six o'clock.

Similarly, *return* (as in *Peter returned home*) expresses a relation between a THING and a PATH incorporating a PLACE, where the PLACE is a place that the THING left from before. This means that for *return* the PATH (incorporating a PLACE) can only be left implicit if assumptions about where the THING left from are easily accessible.

We now can account for Fillmore's examples, given in (4.111):

4.111a. She left home. She left.

b. She left the package. *She left. (op. cit., p.102)

Leave in (4.111a) expresses a relation between a THING and a PLACE, as set out above. This means that, when it is manifest where *she* left from, the PLACE can be left implicit. In (4.122b), *leave* does not express a relation between a THING and a PLACE, but rather it expresses that someone left something somewhere. In other words, there is already an implicit PLACE where *she* left the package. On this reading of *leave* there is no constraint on the THING that can be left somewhere, so that in general it cannot be left implicit, whether or not the PLACE is explicitly stated.

How then can we account for the differences in (4.112)?:

4.112a. When did she leave?

b. *When did she abandon?

c. *When did she vacate? (op. cit., p.99)

Example (112a) can be explained along the same lines as (4.111a). In (4.112b) *abandon* does not put any constraint on the THING that can be abandoned, so that it cannot be left implicit. In (4.112c) *vacate* does put a constraint on the type of THING that can be vacated, i.e. a THING that can contain something. However, it does not constrain what instance of the THING is at stake. Because *vacating* always involves a particular instance of a THING, we cannot leave it implicit.

Fillmore concludes that when a verb can sometimes occur with an implicit argument and sometimes not, this is evidence for the verb being polysemous. However, this is not necessarily the case: as we saw with *follow* in (4.89b) and (4.95), repeated here, we do not have to

propose that *follow* has different meanings in (4.89b) and (4.95) to account for whether it can occur with an implicit argument.

4.89b. The guide left but the tourists didn't follow - they followed the courier instead.

4.95a. ? John$_i$ went to the lecture on astronomy, but he$_i$ couldn't follow.

b. John$_i$ went to the lecture on astronomy, but he$_i$ couldn't follow it.

In these examples it is not the verb that determines the interpretation, but rather the constraint on the THING involved. In the same way, we can account for Fillmore's examples in (4.113) and (4.114):

4.113a. She arrived at the summit.
She arrived.

b. She arrived at the answer.
*She arrived.

4.114a. We returned to the camp.
We returned.

b. We returned to the task.
*We returned. (op. cit., pp.101-102).

In the (a) sentences the PLACES can be left implicit, if it is manifest which PLACE is at stake. Since *answer* and *task* in the (b) sentences are not THINGS that can be viewed spatially as PLACES where a THING is going to, the constraints on the PLACES involved in (4.113b) and (4.114b) will yield a non-spatial interpretation. However, as was the case with *follow* in (4.95), if they are left implicit, it is difficult for the addressee to recover them, because all that the verbs tell her/him is that a particular sort of PLACE is involved, where the THING was going. This again means that a communicator aiming at optimal relevance will have to put an explicit constraint in her/his utterance to guide the addressee to the intended interpretation.

A further example that Fillmore discusses is the verb *give*. Fillmore argues that when we look at when *give* can occur with an implicit argument, it turns out that this only happens when we interpret *give* as 'contribute', and not when we interpret it as giving a gift to a friend. Fillmore says about this that:

> *"If you were to overhear me saying something like*
>
> *(16) I gave a complete set of BLS volumes.*
>
> *(i.e., omitting the TO-phrase), you might conclude that I was talking about my contribution to a departmental book drive, but you would know that I could not be talking about a Valentine's Day present to my wife."* (op. cit., p.100).

Fillmore concludes from this that *give* is ambiguous between a 'contribute' meaning and a 'giving presents' meaning, where only the 'contribute' meaning can be used with an implicit argument. This raises the question of why *give* would have a meaning 'contribute', while there is a separate lexical item *contribute* which expresses the same meaning. The only motivation Fillmore has for proposing a 'contribute' meaning for *give* is that it resembles the verb *contribute* in when it can occur with implicit arguments. However, it turns out that *give* can occur with an implicit argument to express 'giving presents' as well, provided that there is a constraint on the interpretation of the implicit argument, as in (4.115):

4.115. I always give books on birthdays.

In (4.115), *on birthdays* constrains the interpretation of the implicit argument to something like *to people whom speaker gives presents to for their birthdays.*

Why then can't one get a 'present to a person' interpretation in Fillmore's example (16)? In (16) no explicit constraint is given on the interpretation of what or who the BLS volumes are given to. Since *give* itself does not put any constraint on the interpretation of the implicit argument, if you overheard (16), you would have to assume that the communicator intended *a complete set of BLS volumes* to be a sufficient constraint to recover the implicit argument. This then could give access to assumptions such as that a complete set of BLS volumes may be wanted by a university department or a library, because those are places associated with books. Because BLS volumes are not associated with a particular person, a 'present to a person' interpretation is ruled out.

Fillmore notes that with *know* we can leave the argument implicit in the case of (4.116), but not in the case of (4.117):

4.116a. They know that she resigned.
b. They know.

4.117. They know Louise.
*They know. (op. cit., p.102).

In the case of (4.116) *know* expresses a relation between the subject and a thought, i.e. it communicates that *they* know that the propositional form communicated by *she resigned* is true. Thoughts only exist by virtue of people having them, and the only way in which a thought can be made manifest to someone is by communicating that thought in some way. This means that a thought can only be left implicit if it already is mutually manifest to communicator and addressee. Unlike THINGS of which there can be lots which are mutually manifest in a context, the only thoughts which are mutually manifest are thoughts which have been communicated, and of these the thought which is most easily accessible is the thought which is present in the immediate context, i.e. the thought most recently communicated.

In (4.117) *know* does not express a relation between the subject and a thought, but rather it expresses that *they* have a representation of *Louise*, i.e. that they have a conceptual address for Louise which gives access to information about her. In this case *Louise* cannot be left implicit, because, although the interpretation of the argument is constrained by it being a conceptual address, there is no constraint on the particular instance involved.

We can account for *forget, remember, see, hear* and *notice*, as in (4.118) along the same lines as for *know* in (4.116):

4.118a. I forgot that she'd fixed it.
I forgot.

b. I remembered that he was there.
I remembered.

c. I see that they're here.
I see.

d. I heard that you resigned.
I heard.

e. He noticed that she was blind.
He noticed.

In (4.118) the verbs take a thought as an argument, where *forget* and *remember* express what happened to the thought in memory, while *see, hear* and *notice* express how the thought was acquired. For all these verbs the thought can only be left implicit if it is mutually manifest to communicator and addressee.

When *see* and *hear* are used with a THING they constrain the type of THING that can be seen or heard, i.e. objects for *see*, and sounds or

sequences of sounds for *hear*. This means that the THING can be left implicit when one wants to refer to the type, as in (4.119), but not when one wants to refer to a particular instance of a THING, because instances are not constrained, as in (4.120):

4.119. She couldn't see or hear very well anymore.

4.120a. I see the rat.
*I see.

b. I heard the song.
*I heard.

Fillmore notes that when *forget* and *remember* occur with a THING they cannot be left implicit, whereas when they occur with an ACTION they can, as in (4.121-4.122), op. cit., pp.101-102):

4.121a. I forgot my keys.
*I forgot.

b. I forgot to fix it.
I forgot.

4.122a. I remembered my keys.
*I remembered.

b. I remembered to fix it.
I remembered.

However, (4.121a) and (4.122a) do not express that the subject forgot or remembered a THING, but rather that the THING is part of an implicit ACTION, which the subject forgot or remembered to perform, i.e. (4.121a) could express that the subject forgot to bring the keys, while (4.122a) could express that the subject remembered to bring them. This analysis is borne out, when we compare for example (4.121a) to (4.123):

4.123. I forgot the bread.

When (4.123) is uttered by someone who has just come back from shopping, it does not express that s/he forgot the THING 'bread' as a conceptual address, or as an object, nor that s/he forgot to bring the bread, but rather that s/he forgot to buy it. Since this is not recoverable when the THING is left implicit, it follows that it cannot be left implicit.

What we see then is that the view that arguments are part of the conceptual representation of verbs gives us a basis for a semantic/pragmatic account of implicit arguments. On the one hand, the meaning of a verb may constrain the interpretation of the argument that it occurs with, and on the other hand, the interpretation of the rest of the utterance, or assumptions made available by the rest of the utterance may constrain the interpretation of the argument that it

occurs with. We have seen that the relevance theory proposal that communicators aim at optimal relevance accounts for why an argument can only be left implicit under these conditions: they make the interpretation of the implicit argument immediately recoverable. If the interpretation of an argument is not immediately recoverable, the communicator has to put an explicit constraint in the utterance to guide the addressee to the intended interpretation.[6]

4.5. Conceptual structure and logical hypotheses.

We started this chapter by looking at what the notion of 'logical form' means within the framework of relevance theory, and how relevance theory proposes that the logical form of an utterance is recovered during input processing. As we saw, Sperber & Wilson (1986) propose that anticipatory logical hypotheses about the overall structure of the propositional form of an utterance are built during the comprehension process. They propose that these logical hypotheses consist of 'logical categories', which may be regarded as variables over conceptual representations. Although Sperber & Wilson do not specify in detail what these categories are, we saw that Jackendoff proposes a set of basic conceptual categories which are supported by linguistic and non-linguistic evidence. Adopting these categories gives substance to Sperber & Wilson's proposal.

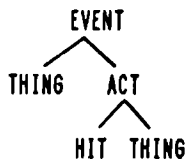
Sperber & Wilson propose that anticipatory logical hypotheses are based on anticipatory syntactic hypotheses, but we saw that this proposal gives rise to a range of problems. Instead of constraining the possible form that the conceptual representation of an utterance can take, this proposal leads to an explosion of different hypotheses, some of which are not realizable as well-formed conceptual structures. The 'language of thought' hypothesis allows for a different view of how anticipatory logical hypotheses are constructed. Given that language of thought representations are structured representations, information about how these representations may be structured has to be stated somewhere. Sperber & Wilson assume that conceptual structure consist of conceptual addresses which give access to different types of information. On the basis of this I proposed that one type of information that conceptual addresses give access to is information concerning conceptual structure. On this proposal, conceptual addresses give access to information concerning how concepts combine to form well-formed formulae in the language of thought, and to information concerning what a concept can combine with to form a

complex concept. This led to the further proposal that structural information is stored in the logical entry of a concept, as logical selection frames.

Postulating that these selection frames are stored in the logical entry of a concept has as a consequence that we can account for how anticipatory logical hypotheses are built without having to appeal to anticipatory syntactic hypotheses: when the addressee accesses the logical entry of a concept, this will give her/him the selection frame which tells her/him conceptual categories the concept needs to combine with in order to yield a well-formed logical form. The addressee can then use this selection frame as an anticipatory logical hypothesis.

It then seemed that information about what arguments a verb, for example *hit*, can occur with can be recovered from the selection frame associated with the concept, e.g. HIT. However, as I have argued above, the view that verbs map onto simple concepts cannot be maintained; rather the arguments that a verb occurs with are an integral part of its meaning, and therefore should be part of its conceptual representation. What this means is that when an addressee recognizes a verb, e.g. *hit* (as in *Pat hit Ann*), s/he will recover the concept in (4.124)[7]:

4.124.



The concept will then give access to the logical selection frame, which specifies what the concept has to combine with to form a well-formed formula in the language of thought (i.e. a proposition). The concept expresses an event, and EVENTS take place somewhere and at some time, which will be specified in the selection frame:

[[EVENT _] [PLACE] [TIME]]
PROPOSITION

Not only can *hit* be individuated as an EVENT, but also as a PREDICATE and more specifically an ACTION (for which I will use ACT) which will therefore be specified in the selection frame, on a separate tier. This tier also shows what the ACT can combine with to form a complex ACT (where the star after PROPERTY indicates that the resulting complex ACT can itself have a PROPERTY again):

[ACT [HIT [THING]] ([MANNER]) ([PLACE]) ([PROPERTY*])]

You can hit a thing in a certain manner, for example, you can hit someone hard, which means that the ACT can combine with a MANNER to yield a complex ACT, although it does not have to. Furthermore, it can be specified where the affected THING was hit, for example, *Pat hit Ann on the head*, which means that the ACT can combine with a PLACE. Moreover, ACTS can have properties, for example, you can hit someone with a stick, which means that the ACT can combine with a PROPERTY to yield a complex ACT. It could be objected that *with a stick* expresses with what kind of instrument the act was performed, rather than a PROPERTY. However, the difference between *Mary hit John* and *Mary hit John with a stick* is not that the first was performed without an instrument, and the second with an instrument: given an appropriate context, we may infer from the first one that Mary hit John with her hand. The function of a PROPERTY containing WITH is simply to modify a conceptual constituent. The way in which this modification is interpreted depends on what we know about the particular concept at stake (encyclopaedic knowledge). Thus, in *a man with a stick*, *with a stick* expresses a property of the instance of MAN at stake, which may be interpreted as that man having a stick, while in *Mary hit John with a stick*, *with a stick* expresses a property of the hitting ACT, which may be interpreted as involving a stick as instrument. In *red with stripes*, *with stripes* expresses a property modifying RED, which may be interpreted as the red being intermingled with stripes; while in *red with anger*, *with anger* expresses a property modifying RED, which may be interpreted as the anger causing the redness. These interpretations depend on encyclopaedic knowledge of the concepts involved, and are arrived at in accordance with the principle of relevance.

As we saw earlier in this chapter, Jackendoff says that VP is the only non-major phrasal category that corresponds to a conceptual category, while all other conceptual categories can be correlated with major phrasal categories. The analysis proposed here provides us with an explanation of why this would be the case. ACTS, and more generally PREDICATES differ from other conceptual categories in that they do not individuate concepts in the way the other conceptual categories do. Although PREDICATES contribute to conceptual structure, particular PREDICATES can only be individuated as part of the concept in whose selection frame they occur, and consequently they get their interpretation from that concept.[8]

What we see then is that logical selection frames specify different sorts of information. In the first place, the selection frame shows

what a concept has to combine with in order to yield a well-formed formula in the language of thought.[9] In the second place, the selection frame will specify what conceptual category the concept belongs to, and what the concept can combine with to form a complex concept (if anything), which will be stated in a separate tier. In the third place, the selection frame will specify constraints on the interpretation of the concept, if there are any.
The concept GIRL will have the logical selection frame:

```
[[EVENT/STATE [THING _ ] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING GIRL ( - [PROPERTY*])]
      some
      individuation
```

The lower tier tells us that the concept GIRL belongs to the category THING, and that it has to be individuated in some way to occur as a constituent in conceptual structure. Moreover, it tells us that GIRL can occur with a PROPERTY, although it does not have to. PROPERTIES modifying THINGS in this way play a different role from e.g. PROPERTIES modifying ACTS. Whereas PROPERTIES modifying ACTS change the nature of the ACT involved, PROPERTIES modifying THINGS help individuate the instance of the THING at stake. This is represented by the hyphen[10]. PROPERTIES modifying THINGS can be either concepts of the conceptual category PROPERTY, or they can be PROPOSITIONS, saying something about the THING at stake.[11]

The upper tier specifies that the whole THING has to combine with some PREDICATE, and the resulting STATE or EVENT has to combine with a TIME, and a PLACE to yield a well-formed formula in the language of thought.

The concept GIRL above has the constraint that it has to be individuated in some way to occur in conceptual structure. A constraint can be more specific than that. For example, the verb *drink* will have the logical selection frame:

```
[[EVENT _ ] [PLACE] [TIME]]
PROPOSITION

[ACT [DRINK [THING      ]] ([MANNER]) ([PROPERTY])]
           TYPE LIQUID
```

In this selection frame it is specified that the type of THING that can be drunk is LIQUID.[12]

A mass noun such as *sugar* will map onto a concept with a logical selection frame similar to that of GIRL. The difference is that it

does not carry the constraint that the THING has to be individuated in some way:

[[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING SUGAR (- [PROPERTY*])]

The effect of this selection frame, i.e. the effect of the absence of the constraint, is that SUGAR can be interpreted as a TYPE of THING.

RED, as in *red socks* gives access to the following selection frame:

[[EVENT/STATE [THING [PROPERTY _] THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

([THING [PROPERTY RED] THING])/ [PROPERTY RED ([PROPERTY])]

The upper tier shows what RED has to combine with to yield a well-formed formula, while the lower tier shows that RED can combine with a THING to become a complex THING, although it does not have to, and that it can combine with another property to yield a complex property.

When we look at what kind of concepts there are, it turns out that we can make a distinction between concepts that occur in conceptual structure and concepts that do not. When we look at this second sort of concept it turns out that their function is to constrain the interpretation of the utterance in which they occur in some way. Within this second group of concepts we can distinguish different sorts of concepts. What they have in common is that none of them gives access to encyclopaedic information: their 'meaning' is exhausted by their logical selection frame, which shows how they constrain the interpretation process. This means that they have no further role to play in general cognitive processes, and consequently they do not have to occur in conceptual structure. What this means is that although they give access to logical selection frames, they themselves do not appear as constituents of these logical selection frames.

In the first place, there are concepts which occur simply to constrain what type of logical hypothesis can be built. For example, complementizer *that* does not occur in conceptual structure, but signals that a proposition is following, by which it constrains the possible logical hypothesis that can be built. In other words, *that* maps onto a conceptual address for *that*, which gives access to its logical selection frame:

[[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[(THING) PROPOSITION]

The lower tier of this logical selection frame simply says that a PROPOSITION is following, which can be individuated as a THING, and the upper tier specifies that it has to combine with certain categories to yield a well-formed formula in the language of thought.

In the second place, there are concepts which do not themselves occur in conceptual structures, but which put constraints on how a particular constituent is interpreted. An example of this is *a(n)*. Verhagen (1986) proposes for the Dutch indefinite article *een* (represented by Verhagen as '[@n]' to show that the vowel is reduced to a schwa) that:

> *"... by using [@n] the speaker presents the idea evoked by the nominal phrase as "instantiated"; thus, the general interpretation of "[@n] X" is, roughly, "instance of X", i.e., "spatio-temporally continuous piece of some 'universe', labelled X". ... [@n] evokes the idea of an instance of a concept; it does not in itself mean that some instance exists."* (Verhagen, 1986, p.118).

When we look at how the indefinite article behaves in English, it turns out that this proposal can be extended to English *a(n)*. Reinterpreted in our framework, this means that what *a(n)* does is signal that an instance of a THING is at stake. In other words, it puts a constraint on the interpretation of a following THING. This means that the phonological or orthographic form *a(n)* maps onto a conceptual address A, which gives access to the following logical selection frame:

[[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Individuation:
Instance

Kempson (1988a) shows how assumptions of Relevance theory can account for the way in which we interpret the definite article. The key to this account lies in the Relevance theory proposal that we can distinguish immediately accessible information (i.e. information accessible at low processing cost) from information in general. Kempson lists what is immediately accessible information as follows:

> *"(A) Representations of information visually present to the speaker and hearer (if suitably picked out, for example by pointing);*
> *(B) Information already represented either in previous*

propositions or in what precedes the part of the utterance the hearer is processing;
(C) Information associated with concepts used in immediately previous linguistic material;
(D) The implicit content of an utterance derived by deduction from the utterance in combination with whatever the hearer takes to be the context;
(E) The logical form of the sentence associated with the utterance being processed. (Kempson, 1988, p.153).

Based on this notion of accessibility of information, Kempson proposes that when a speaker uses a definite expression, s/he indicates that a representation of an NP-type is immediately accessible to the hearer. This proposal can be restated in the framework presented here, by postulating that the definite article maps onto a conceptual address for *the* which gives access to the following logical selection frame:

[[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Individuation:
Accessible instance

Blakemore (1987) shows that discourse connectives should be analyzed as constraints on the pragmatic computations a proposition may enter into. For example, she argues that the meaning of *so* is an instruction to interpret the proposition it introduces as a logical consequence. Blakemore shows that the proposition introduced by *so* can be a logical consequence of a proposition which has been communicated, as in the case of (4.125a) and (4.125b), or the speaker may be drawing attention to a proposition which she has derived from observation of a given state of affairs, as in (4.125c), uttered in the context where the speaker has just seen someone arrive home laden with parcels:

4.125a. There's $5 in my wallet. So I didn't spend all the money then.

b. A: Tom's car isn't here.
B: So he decided not to come after all.

c. So you've spent all your money. (Blakemore, 1987, p.86).

Blakemore argues that discourse connectives such as *so, after all,* and *therefore* do not represent concepts, because they do not occur in conceptual structure. Instead, she proposes that they are part of :

"... [an] essentially procedural theory that deals with the

> *way in which elements of linguistic structure map directly onto computations themselves - that is, onto mental processes. ... a complete account of the relationship between linguistic form and pragmatic interpretation must include not just a theory of logical form, but also a theory of grammatically specified constraints on pragmatic computation."* (op. cit., p.144).

Although Blakemore says that this 'procedural theory' should account for the way in which elements of linguistic structure map onto mental processes, when she discusses *after all* she says:

> "*... after all is not part of a linguistic representation which is developed into a proposition, but imposes a constraint on the pragmatic computations a proposition may enter into.*" (op. cit., p.125).

This raises a number of problems. Blakemore does not give an account of how a discourse connective can be an element of linguistic structure, but nevertheless not be part of the linguistic representation that she assumes is computed in the interpretation process. The assumption that a linguistic representation is computed entails that a representation is made of how the different linguistic elements are structurally related. The claim that discourse connectives are elements of linguistic structure which nevertheless are not incorporated into linguistic representations, calls for some explanation of how they are represented.

Also, Blakemore views discourse connectives not as putting constraints on how linguistic representations are processed, but rather as constraints on the pragmatic computations that a proposition may enter into. This means that the constraints must be represented in a format that can be 'read' by the central cognitive device, i.e. they must be represented in the language of thought. Furthermore, when we look at Blakemore's proposal for the meaning of *so* as an instruction that the proposition it introduces is a logical consequence, we see that by necessity *so* introduces a proposition. Again, this information has to be stated somewhere.

Given the proposal that there are concepts which do not occur in conceptual structure, we can reanalyze Blakemore's proposals. We can view discourse connectives as mapping onto concepts which give access to logical selection frames. These selection frames give access to information concerning what logical hypothesis should be built and, moreover, to information which puts a constraint on how the resulting propositional form should be interpreted. On this view, we can say

that *so* maps onto a concept SO which gives access to the following logical selection frame:

[PROPOSITION]
logical consequence of proposition in context

Represented in this way, we do not have to postulate that there is a separate 'procedural theory' to account for the interpretation of discourse connectives. A consequence of this is that we end up with a unified account of constraints on interpretation: constraints may range over the kind of logical form that can be built, they may range over the interpretation of elements within a logical form (as is the case with the interpretation of THING when it occurs with *drink*), or they may range over whole propositions, as is the case with *so*.

With these logical selection frames, we can now account for how anticipatory logical hypotheses are built: when the addressee accesses the logical entry of a concept, this will give her/him the selection frame, which tells her/him how to construct a well-formed formula in the language of thought. The addressee can then use this selection frame as an anticipatory logical hypothesis. In the next chapter, I will discuss the actual process of building anticipatory logical hypotheses more extensively, and I will propose an input-processing model which operates by building these anticipatory logical hypotheses. I will show that this model is compatible with the experimental findings, and moreover how it can account for experimental findings which have presented problems for existing models.

Chapter 5: A Relevance-driven model of input processing.

In most existing processing models little or no account is taken of the fact that the use of natural language is a process of interaction between communicator and addressee, in which both parties are involved in establishing successful communication. Work on 'context-neutral' languages for computers, and on Artificial Intelligence seems to have influenced psycholinguists in trying to explain input processing phenomena purely in terms of hearers'/readers' activity, without taking into account that the communicator is responsible for the input:

> *"It is natural to think of perception and comprehension as including analogues of the parsing operations of formal grammars, and so to view A.I. parsing schemes as potential models of (portions of) some mental processes."* (Karttunen & Zwicky, 1985, p.9).

Natural language use, however, is more than the use of a 'context-neutral' language with the context added: as Relevance theory shows us, the choice of a particular utterance is a consequence of the context in which it is uttered. Communicators intend their audience to believe that they are worth paying attention to, and addressees only pay attention to information which seems relevant to them. As we have seen, the principle of Relevance says that:

> *"Every act of ostensive communication communicates the presumption of its own optimal relevance."* (Sperber & Wilson, 1986, p.158)

where the presumption of optimal relevance is defined as:

> *"a) The set of assumptions {I} which the communicator intends to make manifest to the addressee is relevant enough to make it worth the addressee's while to process the ostensive stimulus.*
> *b) The ostensive stimulus is the most relevant one the communicator could have used to communicate {I}.* (op. cit., p.158).

It follows from this that a communicator aiming at optimal relevance will not only try to make her/his utterance worth the addressee's while on the message level, but will also try to keep processing cost down, by accommodating her/his choice of linguistic output to the processing needs of the addressee.

This view of communicator/addressee interaction together with the notion of logical hypothesis building has consequences for a model of input processing, because it forces us to look at the interpretation process as a process in which the addressee expects the communicator to

be aiming at optimal relevance, and in which s/he will interpret an utterance according to this expectation.

5.1. The model.

I propose a processing model, in which the on-line interpretation process is driven by the principle of Relevance, a model which takes into account that the input for comprehension is never 'neutral', but is produced by a communicator aiming at optimal relevance.

I will not have anything to say about the role of the prosodic processor, although I assume that prosodic properties play a role in the building of logical forms, by delimiting local phrases, and that they have an effect on the choice of context in which an utterance will be processed, by delimiting foreground and background assumptions.

Likewise, I will not have anything to say about the way in which the phonological form (or orthographic form) of a lexical item is recognized during the interpretation process.

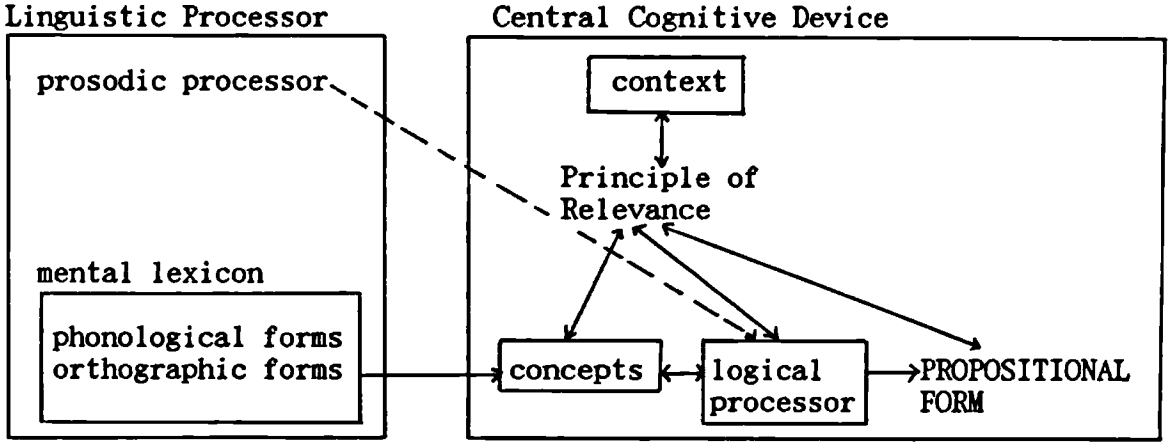


Figure 5.1) A Relevance driven model of input processing.

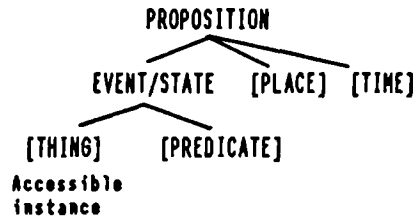
In this model the 'linguistic processor' is responsible for recognizing the phonological (or orthographic) form of a lexical item. It does not, however, assign it to a syntactic category, nor does it assign a syntactic structure to the string of lexical items that make up an utterance. The phonological (or orthographic) forms give access to the concepts associated with them. The logical processor accesses the logical entry of the concept, which will give it the logical selection frame associated with the concept. Based on the selection frames of concepts, anticipatory logical hypotheses are made. These logical hypotheses can be enriched by accessing the context and the encyclopaedic entries of concepts, in accordance with the principle of Relevance, until a fully propositional form has been built.

Let us consider how, given this model, an addressee would process an utterance like *The girl is in the room.* When an addressee who is processing *The girl is in the room* recognizes *the*, this will map onto the concept THE, which gives access to the logical selection frame (Lsf) of THE:

THE Lsf: [[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Individuation:
Accessible instance

The higher tier will yield a logical hypothesis, while the lower tier gives a constraint on the interpretation of the following THING[1]:

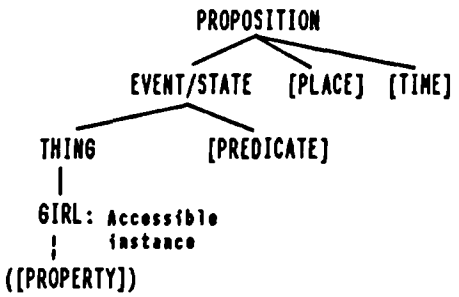


When *girl* is recognized, the addressee already has a logical hypothesis available. This has as a consequence that although GIRL gives access to the whole logical selection frame for GIRL, there is no need to use the information in the higher tier, because all the addressee has to do is enrich the logical hypothesis s/he already has, not build a new one:

GIRL Lsf: [[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

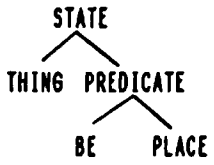
[THING GIRL (- [PROPERTY])]
some
individuation

The information in the lower tier together with the logical hypothesis built on encountering THE, then yields the further hypothesis:



This logical hypothesis enables the addressee to look for an accessible instance of a GIRL, in accordance with the principle of Relevance.[2]

Then when *is* is recognized this maps onto the concept:

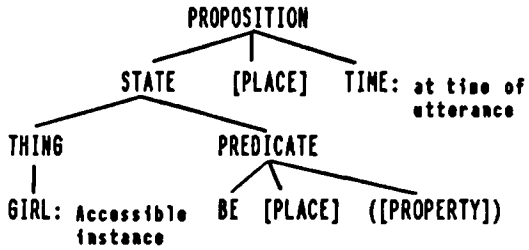


The conceptual address gives access to the logical selection frame:

BE Lsf: [[STATE _] [PLACE] [TIME]]
PROPOSITION

[PREDICATE [BE [PLACE]] ([PROPERTY])]

Again the information in the higher tier in the selection frame is not used, because there already is a logical hypothesis, in which the information from the lower tier can be incorporated. Moreover, the verb itself yields the information that it expresses a STATE, which modifies the resulting logical hypothesis, while the present tense puts a constraint on the interpretation of TIME[3]. The interpretation of TIME may be further enriched then shown here, if this is needed to yield a relevant interpretation:[4]



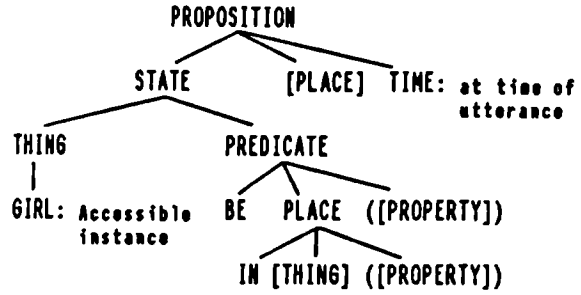
Prepositions are like verbs, in that their arguments form an integral part of their meaning.[5] This means that the preposition *in* maps onto the concept:

This will give access to the logical selection frame:

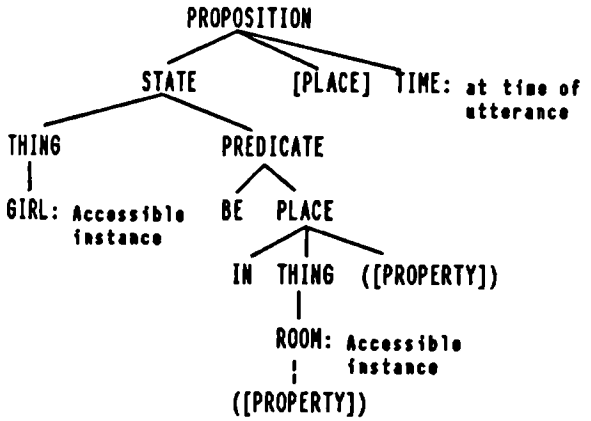
IN Lsf: [[EVENT/STATE] [PLACE _] [TIME]]
PROPOSITION
[[STATE [THING] [PREDICATE BE [PLACE _] [PLACE] [TIME]]
PROPOSITION

[PLACE IN [THING] ([PROPERTY])]

The information retrieved from this selection frame can be incorporated into the logical hypothesis:



On encountering *the*, the information can be added that an accessible instance of a THING is at stake, while *room* supplies the information what kind of THING is at stake. This enables the addressee to look for an accessible instance of a room, in accordance with the principle of Relevance:



If the communicator achieved optimal relevance, what the addressee ends up with at the end of the utterance is the propositional form of the utterance *The girl is in the room.* What we see is that not all the conceptual category slots needed to yield a well-formed formula are filled. If a category slot is not filled by conceptual material, then the addressee will interpret it as expressing some instance of the conceptual category. However, if it is relevant for the addressee which instance is at stake, e.g. at what PLACE the above STATE held, then s/he has to recover this information in accordance with the principle of relevance. If the addressee cannot supply this information, then s/he will not find a relevant interpretation and communication fails.

All that an addressee needs in the interpretation process is to recover the phonological form of a word from the mental lexicon and then access the logical entry of the concept associated with that phonological form. As a consequence there is no role left for a syntactic parser in this model. It is generally assumed that we need to postulate a parser to account for how the addressee recovers the

structure of an utterance. However, the aim of the interpretation process is not to recover the linguistic structure of the utterance, but rather to compute a propositional form which gives rise to adequate contextual effects for as little processing cost as possible. In order to do this an addressee needs to recover the logical form of an utterance. Because in many instances the linguistic form of an utterance underdetermines the logical form of the proposition expressed, analyzing the syntactic structure of the linguistic input will not provide the addressee with all the information required to construct the right logical form. This means that if a linguistic syntactic representation were computed, this would not provide the whole basis for the logical form representation. Moreover, postulating that a syntactic representation is computed raises the question of how this syntactic representation is 'translated' into or mapped onto a (non-linguistic) logical form; as we have seen, we cannot maintain that anticipatory logical hypotheses are built on the basis of syntactic hypotheses. If we want to maintain the view that syntactic structure is computed, we have two possibilities. In the first place, we could postulate that syntactic structure is computed and mapped onto logical form in some way. However, on this view we need to account for how the logical form can be richer than the syntactic structure of the linguistic input. Moreover, on this view we lose the possibility of having logical hypotheses, which Sperber & Wilson (1986) see "*as playing a crucial role in disambiguation and reference assignment*" (op. cit., p.206). In the second place, we can postulate that syntactic structure is computed, but that logical hypotheses are constructed independently of this syntactic structure. However, if we can construct the logical form of an utterance independently of the syntactic structure of the linguistic input, then recovering that syntactic structure does not contribute anything to the interpretation process.

As we saw in chapter 1, section 1.1, the experimental evidence cited to show that syntactic structure is computed either does not in fact show this (e.g. Forster & Olbrei, 1973), or is open to a different interpretation (e.g. Tanenhaus et al., 1985). On the other hand, the experimental findings by Tyler & Warren (1987) support the view that (at least) no overall syntactic representation of an utterance is constructed. As we saw in section (1.1), Tyler & Warren conducted a number of experiments to see how listeners use the global and local

structural organization of an utterance in the process of language comprehension. Some of the sentences they used are repeated here:

5.1a. Late target (syntactically well-formed)

An orange dream/ was loudly watching/ the house/ during smelly lights/ because within these signs/ A SLOW KITCHEN/ snored/ with crashing leaves.

b. Scrambled (global syntactic disruption)

Because within these signs/ during smelly lights/ was loudly watching/ the house/ an orange dream/ A SLOW KITCHEN/ snored/ with crashing leaves.

c. Syntactic disruption (local)

An orange dream/ was loudly watching/ the house/ during smelly lights/ because within these signs/ SLOW VERY KITCHEN/ snored/ with crashing leaves.

As we saw, Tyler & Warren found that response times to sentences with global syntactic disruption were not significantly slower than than those in the late condition, but disruption of the local syntactic structure did significantly slow down response times as compared to the late condition. Tyler & Warren argue that these findings show that the addressee does not construct a syntactic representation which spans anything larger than a local phrase. To account for their findings they propose that in processing an utterance the addressee uses prosodic, syntactic and semantic information to construct local phrases. These local phrases are integrated together into a "higher level" representation by means of the semantic and prosodic relationships between the phrases, so that a syntactic level of representation which spans the entire utterance is not constructed. A problem with this is that it presents us with a parser which utilizes the rules of syntax to construct representations of local phrases but not of larger sequences of phrases, without an account of why this would be the case.

The model proposed here can account for these findings in a straightforward way, without having to postulate a syntactic parser which only operates over local phrases. In all three conditions the addressee will build anticipatory logical hypotheses. In the late condition the different concepts will fall into the slots present in the logical hypotheses in a linear fashion. Although in the scrambled condition the concepts cannot be fitted in the logical hypotheses in a

linear fashion, the addressee has slots available for the concepts so that the interpretation process will not be slowed down much. In the (local) syntactic disruption condition, on the other hand, no slot will be available for VERY, while KITCHEN cannot be fully interpreted, so that the process of propositional form building will be slowed down. To illustrate this let us look at the process of logical hypothesis building for these two latter conditions in more detail:

5.1b. Scrambled (global syntactic disruption)

> Because within these signs/ during smelly lights/ was loudly watching/ the house/ an orange dream/ A SLOW KITCHEN/ snored/ with crashing leaves.

When processing (5.1b), the addressee first encounters BECAUSE. Blakemore (1988) analyzes *because* (at least on one reading) as expressing a logical relationship, in that it introduces a premise for a conclusion, i.e. it introduces evidence for another proposition. Within our framework, this means that BECAUSE gives access to the logical selection frame:

BECAUSE Lsf: [[PROPOSITION$_i$] [PROPOSITION$_{ii}$]]

[PROPOSITION$_i$]
evidence for proposition$_{ii}$

From this selection frame the addressee can built the logical hypothesis that two propositions will follow. Then when s/he encounters *within*, this will map onto the concept:

PLACE

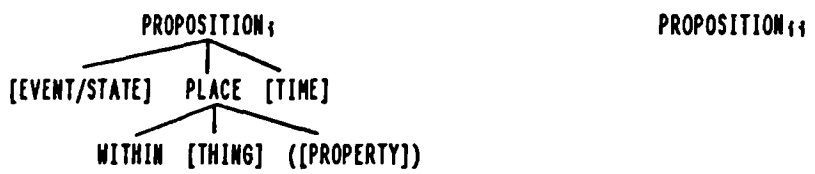
WITHIN THING

This will give access to the logical selection frame:

WITHIN Lsf: [[EVENT/STATE] [PLACE _] [TIME]]
PROPOSITION

[PLACE WITHIN [THING] ([PROPERTY])]

Since there is no PLACE slot in the existing logical hypothesis, the addressee will have to access the whole selection frame. However, there is a PROPOSITION slot so that the information in this logical selection frame can be incorporated into the logical hypothesis:



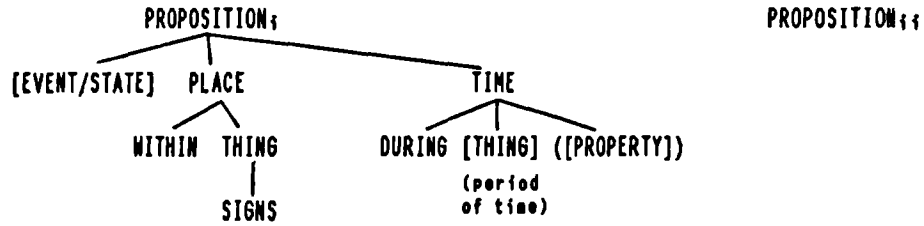
On encountering *these* the addressee will recover that some accessible spatially near THINGS will follow, while *signs* specifies what kind of THING is at stake; this can be fitted into the THING slot already available in the logical hypothesis. On encountering *during*, this will map onto the concept:

This concept will give access to the logical selection frame:

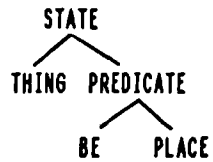
DURING Lsf: [[EVENT/STATE] [PLACE] [TIME _]]
PROPOSITION

[TIME DURING [THING]([PROPERTY])]
period of time

Because the addressee already has a logical hypothesis, only the lower tier will be accessed, which can then be incorporated in the logical hypothesis:[6]



SMELLY and LIGHTS can be fitted into the THING slot. Then when *was* is recognized, it maps onto the concept BE:



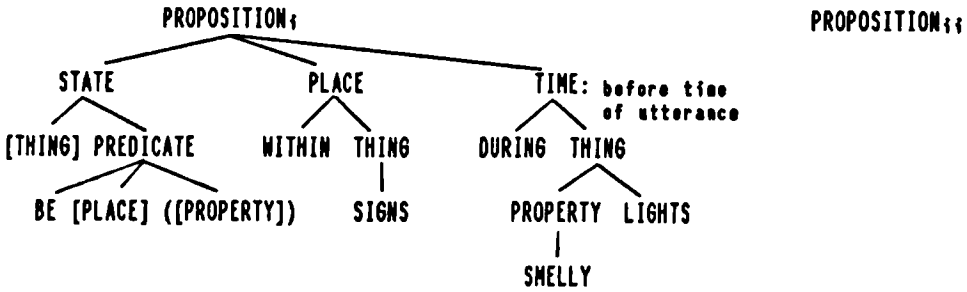
This concept gives access to the logical selection frame:

BE Lsf: [[STATE _] [PLACE] [TIME]]
PROPOSITION

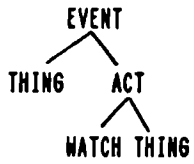
[PREDICATE [BE [PLACE]] ([PROPERTY])

Because there is no PREDICATE slot in the logical hypothesis, the whole selection frame is accessed, which yields the information that BE expresses a STATE which has to combine with a PLACE and a TIME to yield a PROPOSITION. Since there is an empty STATE/EVENT slot in the logical hypothesis which combines with a PLACE and a TIME, the information from the selection frame can be incorporated into the

logical hypothesis. Moreover, the past tense puts a constraint on the interpretation of TIME:



LOUDLY WATCHING will then be interpreted as a circumstantial PLACE. *Watching* will map onto the concept WATCH:



However, the 'ing' part causes the addressee to access a different logical s-selection frame:[7]

WATCH-ING Lsf: [[STATE/EVENT [ACT _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION
[[ACT _] [EVENT] [PLACE] [TIME]]
PROPOSITION

[ACT[WATCH [THING]] ([MANNER]) ([PROPERTY])]/
[CIRCUMSTANTIAL [ACT[WATCH [THING]] ([MANNER]) ([PROPERTY])]]
PLACE

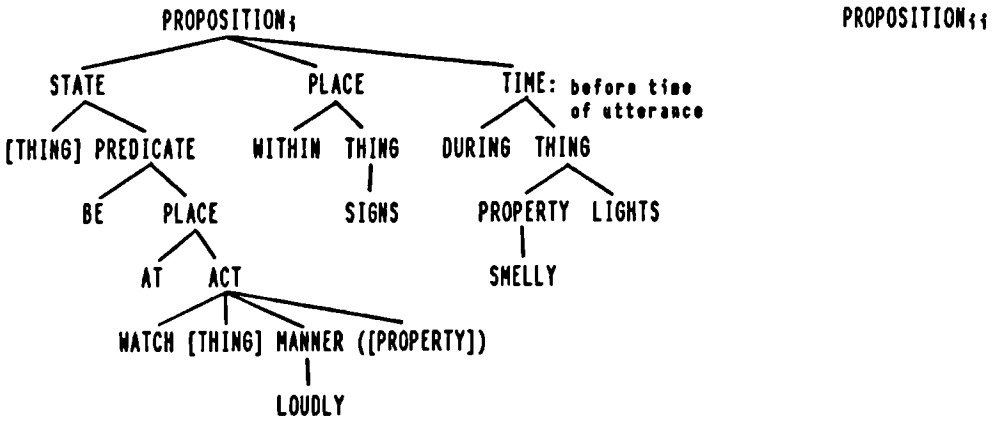
This selection frame says that the ACT must either combine with a predicate to yield a STATE or EVENT, which in turn combines with a PLACE and a TIME to yield a PROPOSITION, as in (5.2):

5.2. Watching television is addictive.

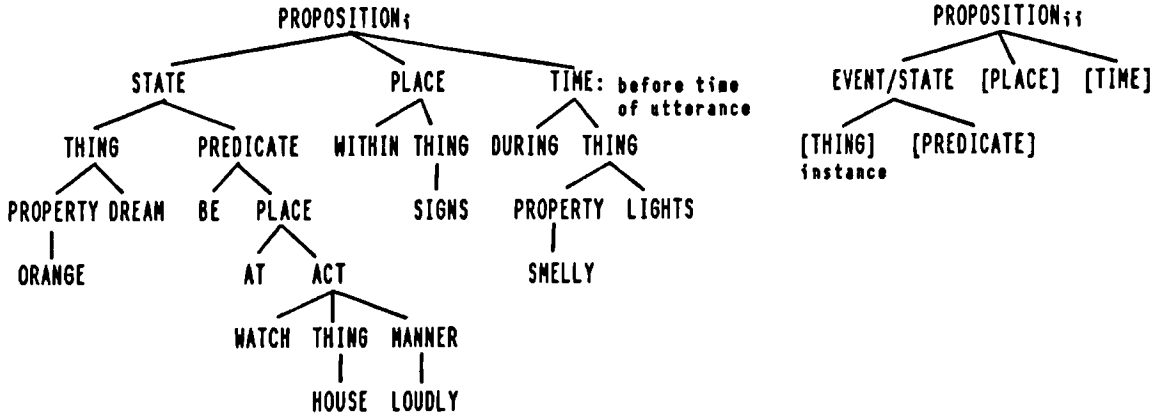
or that it combines with an EVENT, a PLACE and a TIME to yield a PROPOSITION, as in (5.3):

5.3. Watching his feet, John tried to tango.

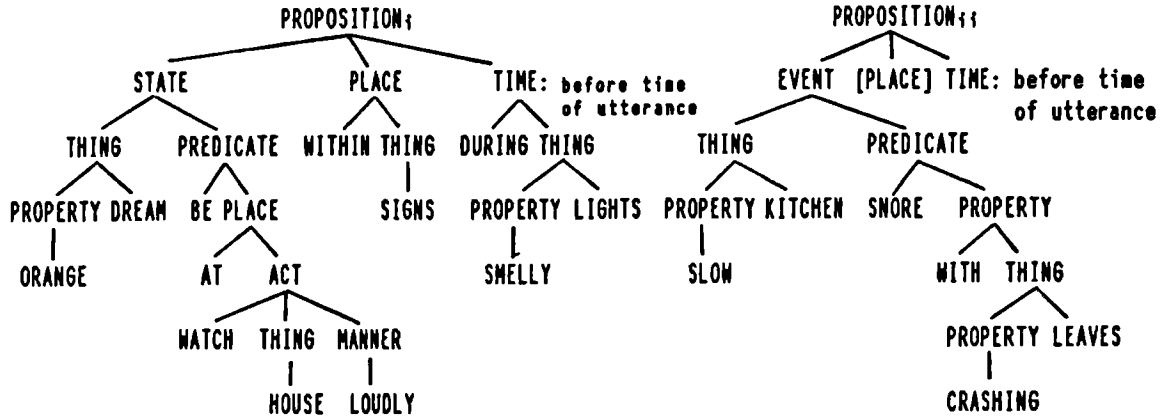
Furthermore, it says that the ACT can combine with a MANNER and a PROPERTY to yield a complex ACT, and that the ACT can occur as a CIRCUMSTANTIAL PLACE. Since the addressee already has a logical hypothesis, only the lower tier of the selection frame needs to be accessed, which yields the logical hypothesis:



HOUSE will be fitted into the most accessible THING slot, i.e. the slot most recently postulated, while ORANGE DREAM will be fitted into the remaining THING slot. When *a slow kitchen* is encountered, no more THING slots are available, so that it cannot be fitted into the first PROPOSITION. However, the logical hypothesis states that there is a second PROPOSITION coming, and by accessing the complete logical selection frame of the indefinite article, the addressee recovers how this PROPOSITION is going to be build:



The rest of the utterance can then be fitted into the logical hypothesis, until the propositional form has been recovered:



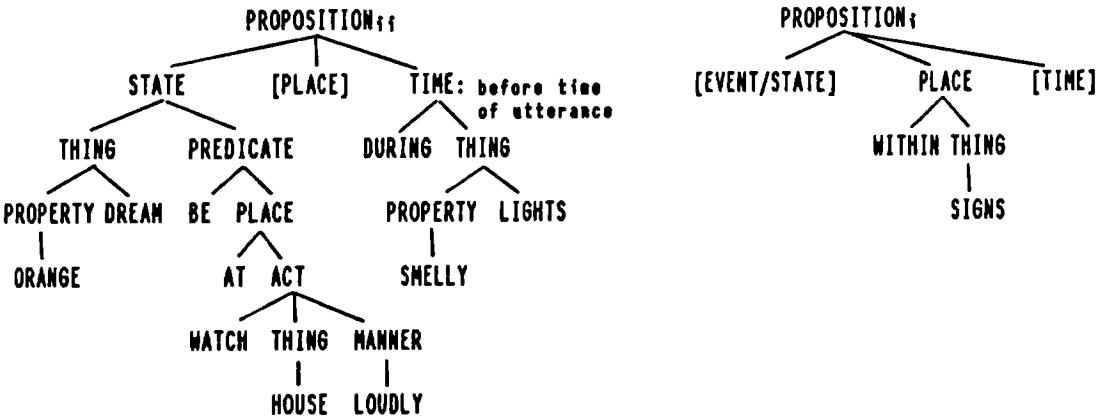
What we see then is that it does not matter that the syntactic structure of the utterance is globally disrupted: although the different concepts cannot be fitted into the logical hypothesis in a left-to-right fashion, for all concepts there are conceptual slots available in the logical hypothesis into which they can be fitted.

When we look at the locally disrupted sentence, repeated here, it turns out that with this sentence there is no conceptual slot available in the logical hypothesis into which the concept VERY can be fitted, and moreover that KITCHEN cannot be fully interpreted.

5.1c. Syntactic disruption (local)

> An orange dream/ was loudly watching/ the house/ during smelly lights/ because within these signs/ SLOW VERY KITCHEN/ snored/ with crashing leaves.

When processing this sentence, the addressee builds logical hypotheses in the way set out before. When the addressee encounters SLOW, s/he has the following logical hypothesis available:

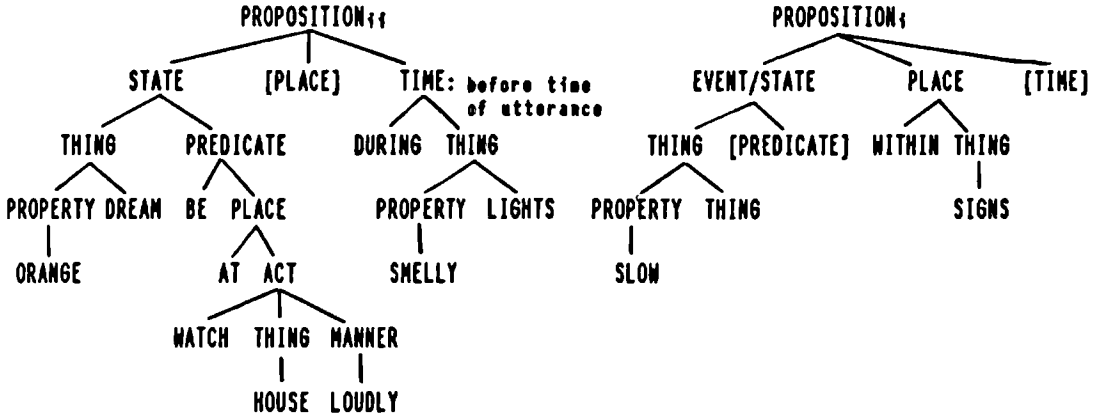


SLOW gives access to the logical selection frame:

SLOW Lsf: [[EVENT/STATE [THING [PROPERTY _] THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

([THING [PROPERTY SLOW] THING])/ [PROPERTY SLOW ([PROPERTY WITH [THING]])]/
[PROPERTY SLOW ([PROPERTY $PLACE_{circ}$])]

Because there is no THING or PROPERTY slot in the logical hypothesis, the addressee has to access the upper tier of the selection frame, which tells her/him that SLOW has to combine with a THING to form a complex THING which is part of an EVENT or STATE. Because there is an EVENT/STATE slot in the logical hypothesis, this information can be built into the logical hypothesis so that when the addressee reaches *very*, s/he has the following hypothesis available:



The concept VERY gives access to the logical selection frame:

VERY Lsf: [[STATE/EVENT [THING [PROPERTY [AMOUNT _] PROPERTY] THING] [PRED]] [PLACE] [TIME]]
PROPOSITION
[[EVENT [THING][ACT [MANNER [AMOUNT _] MANNER]] [PLACE] [TIME]]
PROPOSITION

[PROPERTY [AMOUNT _] PROPERTY]
[MANNER [AMOUNT _] MANNER]

The upper tiers specify what VERY must combine with to yield a PROPOSITION, while the lower tiers show that VERY is always part of a complex concept, either a PROPERTY, or a MANNER. When we look at the logical hypothesis the addressee has, there is no empty MANNER nor PROPERTY slot available. This means that VERY cannot be fitted into the logical hypothesis in a straightforward way. Accessing the upper tiers of the selection frame does not help, because there is no PROPOSITION slot available in the logical hypothesis either. This means that VERY cannot be integrated within the logical hypothesis, which will cause an increase in processing time.

When KITCHEN is recognized, this will give access to the selection frame:

KITCHEN Lsf: [[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING KITCHEN (- [PROPERTY])]
sem
individuation

Although there is a THING slot available in the logical hypothesis, the lower tier of the selection frame specifies that KITCHEN needs to be individuated in some way. Because no individuating concept (such as an article or demonstrative) has been encountered, the addressee does not know how to interpret KITCHEN, which again will lead to an increase in processing cost.

What we see then is that Tyler and Warren's findings are accounted for naturally within this framework, without us having to postulate that the addressee constructs a syntactic representation of individual phrases but not of sequences larger than individual phrases.

5.2. Issues of on-line comprehension.

The model proposed here not only can accommodate the findings by Tyler & Warren, it can account for the other experimental findings discussed in this thesis, including findings which have presented problems for processing models with a syntactic parser, e.g. multiple centre-embedded sentences. In order to do this, we have to address one more question. Sperber & Wilson (1986) propose that processes such as disambiguation and reference assignment take place on-line, on the basis of anticipatory logical hypotheses, and in accordance with the principle of Relevance, i.e. the addressee will go for the interpretation which yields adequate contextual effects for as little processing effort as possible. The different sorts of contextual effects are clearly defined by Sperber & Wilson (see section 1.2.5). The question then is what constitutes processing effort.

5.2.1. Processing effort.

A partial answer to the question of what constitutes processing effort is provided by the Relevance theory notion of accessibility. Relevance theory proposes that the interpretation of a linguistic input depends on its interaction with assumptions (the context) which are either already held in memory, or can be constructed from assumption schemas, to yield contextual effects. These assumptions and assumption schemas have to be retrieved from memory. The more accessible an assumption is, the easier it is to recall from memory. What makes an assumption accessible? As we saw in the last chapter, Kempson (1988) lists what is immediately accessible information as follows:

> *"(A) Representations of information visually present to the speaker and hearer (if suitably picked out, for example by pointing);*
> *(B) Information already represented either in previous propositions or in what precedes the part of the utterance the hearer is processing;*
> *(C) Information associated with concepts used in immediately previous linguistic material;*
> *(D) The implicit content of an utterance derived by deduction from the utterance in combination with whatever the hearer takes to be the context;*
> *(E) The logical form of the sentence associated with the utterance being processed.* (Kempson, 1988, p.153).

Relevance theory proposes that contexts are ordered according to accessibility, and that extending a context is a cyclic process, i.e. only some extended contexts are accessible from the immediate context, but these extended contexts make further extensions accessible, which in turn make further extensions accessible, etc. Actually accessing a context involves processing effort, and each step of context extension involves more processing effort, so that from this we can conclude that the fewer steps of context extension needed to yield an interpretation with adequate contextual effects, the smaller the processing effort. However, this is not all that needs to be said about processing effort.

In many of the psycholinguistic experiments discussed in this thesis, ambiguous sentences, such as the ones in (5.4), and 'garden-path' sentences, such as in (5.5), are presented to subjects in isolation, i.e. the 'null context':

5.4a. Joyce said Tom left yesterday.
b. John hit the girl with a book.

5.5a. Since Jay always jogs a mile seems like a short distance to him.
b. The horse raced past the barn fell.

When these sentences are presented to subjects in isolation, they are not acts of ostensive communication, i.e. they are not used to communicate propositions to the subjects. This means that going for one rather than the other interpretation is not going to give the subject more contextual effects, e.g. knowing that Joyce said something yesterday does not give the subject more contextual effects than knowing that Tom left yesterday, if the subject does not know who Joyce and Tom are, etc. Moreover, by formulating these sentences the researchers are not aiming at optimal relevance, i.e. they are not accommodating the choice of sentence to the processing needs of the subjects. A communicator actually uttering one of the sentences above would only do so if the utterance is the most relevant one s/he could use in order to communicate the proposition s/he wants to convey, i.e. when it accommodates the processing needs of the addressee best. This means that experiments in which sentences are processed in isolation do not necessarily reflect normal utterance interpretation: the initial context in which the sentence is processed does not contain any assumptions that have a bearing on the interpretation, and the interpretation of the sentence will yield no or very little contextual effects. However, as we have seen, it has been found that ambiguous

sentences, as in (5.4), have a favoured interpretation when processed in isolation, i.e. (5.6):

5.6a. Joyce said (Tom left yesterday).
b. John (hit (the girl) (with a book)).

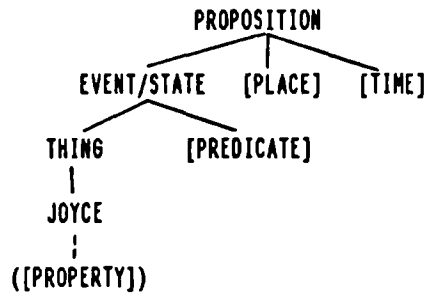
and the 'garden-path' sentences, as in (5.5), are called so because they cause subjects to go for the wrong analysis (again when processed in isolation). If we cannot account for this in terms of contextual effects, we will have to account for it in terms of processing effort. However, when we look at, e.g. (5.4a), the difference in processing effort between the two analyses cannot be explained in terms of numbers of context extensions involved in the different interpretations, because extending the context does not make one interpretation more relevant than the other. Why then does the favoured interpretation involve less processing effort? When we look at what happens when (5.4a) is processed, it turns out that 'accessibility' does not just apply to assumptions, but also to conceptual slots in the logical hypothesis.

When the addressee encounters *Joyce*, this will give access to the logical selection frame:[8]

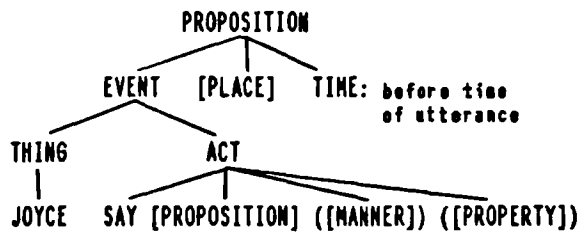
JOYCE Lsf: [[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING JOYCE (- [PROPERTY*])]

This logical selection frame will yield the logical hypothesis:



On encountering *said* the PREDICATE slot can be filled by SAY [PROPOSITION] ([MANNER]) ([PROPERTY*]), and moreover, the past constrains the TIME slot to BEFORE TIME OF UTTERANCE:[9]

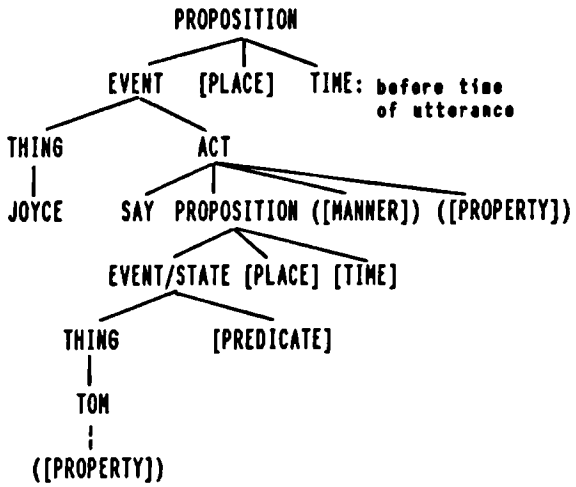


TOM gives access to the Logical selection frame:

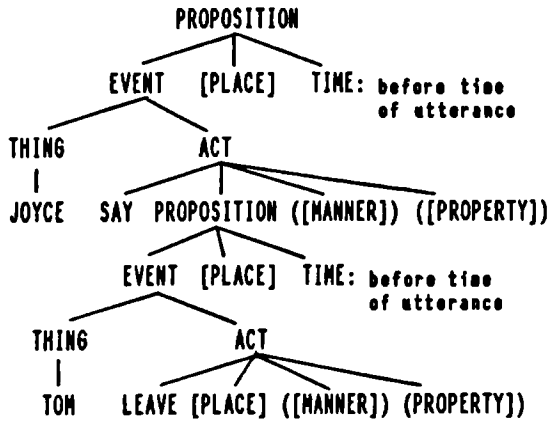
TOM Lsf: [[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING TOM (- [PROPERTY*])]

Because there is no THING slot available in the logical hypothesis, the whole logical selection frame has to be accessed, so that TOM will be taken as the start of the subordinate PROPOSITION, in the logical hypothesis:



On encountering *left* the PREDICATE slot can be filled by LEAVE [PLACE] ([MANNER]) ([PROPERTY]), and moreover, the past constrains the TIME slot to BEFORE TIME OF UTTERANCE.



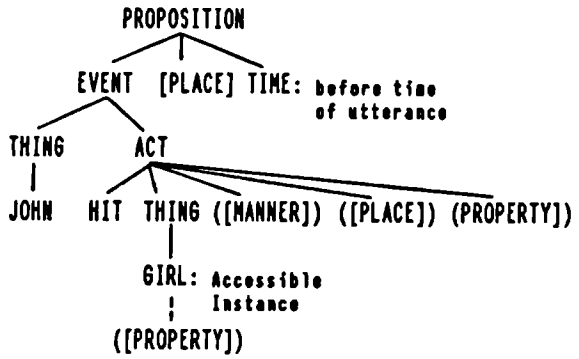
On encountering YESTERDAY, this will be fitted into the most accessible TIME slot, which in this case is the TIME slot in the subordinate PROPOSITION. What makes this the most accessible slot? A conceptual slot is the most accessible when it is being inserted in a logical hypothesis, when it is being filled, and when a constraint is put on its interpretation. When new conceptual slots are inserted into the logical hypothesis, they in turn become more accessible.[10] In (5.4a) the TIME slot in the subordinate PROPOSITION is the TIME slot

postulated most recently, and moreover the tense of LEAVE has put a constraint on its interpretation immediately before YESTERDAY is encountered, so that it is more accessible than the TIME slot in the main clause. Because of this, the processor will not even consider the TIME slot in the main clause. Only if YESTERDAY is incompatible with conceptual material already available, e.g. in the case of *Joyce said Tom is leaving yesterday*, or if it is incompatible with assumptions in the context, will this assignment be rejected, and the TIME slot in the main PROPOSITION tried. Because rejecting the first interpretation, and going for the TIME slot in the main PROPOSITION would involve more processing effort, which is not offset by an increase in contextual effects, 'Joyce said (Tom left yesterday)' is the most relevant interpretation, and therefore the interpretation that the addressee goes for when processing (5.4a) in isolation.

When (5.4b), repeated here, is processed in isolation, it is interpreted as (5.6b), rather than (5.6c):

5.4b. John hit the girl with a book.
5.6b. John (hit (the girl) (with a book)).
5.6c. John hit (the girl with a book).

Again, we can account for this by looking at how the logical hypothesis for this sentence is built. By the time the addressee encounters *with*, s/he has the following logical hypothesis available:



The addressee then has two optional PROPERTY slots available. Optional slots differ from the other slots in a logical hypothesis in that they do not have to be filled by any conceptual material in order to yield a well-formed formula: they merely show what a concept can combine with to form a complex concept, or, as is the case with PROPERTIES following THINGS, they can help the addressee to pick out the THING at stake. This means that they do not become immediately accessible on being inserted in the logical hypothesis. Rather, optional slots become accessible either when the addressee recovers a

concept of the same type which cannot be inserted into a slot which has to be filled in order to yield a proposition, or they can become accessible because assumptions in the context make the complex concept relevant. In the case of (5.4b) the addressee accesses the logical selection frame of WITH, and finds that WITH THING is a PROPERTY. This then makes both optional PROPERTY slots in the logical hypothesis accessible.

Why then would the addressee go for the interpretation in (5.6b)? Concepts do not only give access to their logical selection frames, but also give access to encyclopaedic information. For (5.4b) this means that the addressee has access to encyclopaedic information for JOHN, HIT and GIRL by the time s/he encounters WITH THING. The concept WITH THING together with HIT makes accessible the assumption that we can hit people with something, while WITH THING together with GIRL does not make accessible any assumptions which help assign reference to the GIRL. In order to accommodate WITH THING as a PROPERTY of GIRL the addressee would have to make extra assumptions, which would involve extra processing effort because it would involve creating a context, which means extending the accessible context. Because the addressee aims for the interpretation which involves least processing effort, assigning WITH THING to the PROPERTY of HIT is the only assignment that the addressee can go for. This assignment is borne out when the addressee encounters *a book*. If the THING turns out to be incompatible with being an instrument used in hitting, e.g. *the blue eyes*, this will lead to reanalysis.

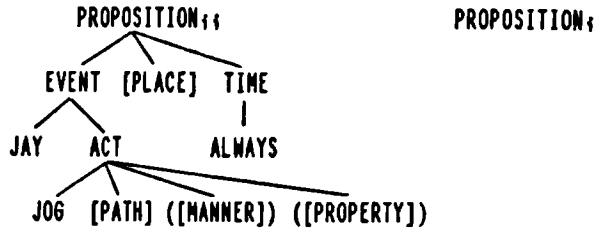
What we see then is that even when a sentence like (5.4b) is processed in isolation, the addressee goes for the interpretation which is supported by the (limited) context which is created during the interpretation process. This does not mean that when a sentence like (5.4b) is actually used as an act of ostensive communication, the addressee will always go for this analysis first. If the context does not enable the addressee to assign reference to GIRL before WITH THING is encountered, and it is important to the addressee to know which girl is meant (e.g. when there are several girls in the context), then WITH THING will be assigned to the PROPERTY slot of GIRL.

As we have seen, when subjects process a sentence like (5.5a), repeated here, in isolation, they get 'garden-pathed', because they take *a mile* to be the object of *jogs*, rather than the subject of the main clause.

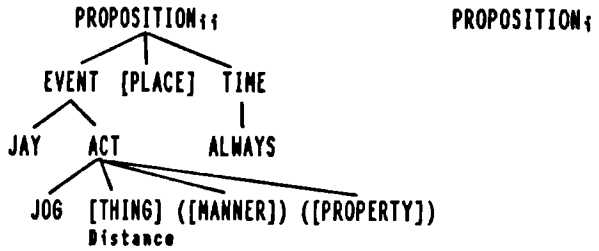
5.5a. Since Jay always jogs a mile seems like a short distance to him.

Jog is ambiguous among a number of different readings, which means that it maps onto different concepts, causing the addressee to build different logical hypotheses[11]:

1.



2.



Because the addressee cannot choose between these logical hypotheses at this stage, s/he will maintain both. These logical hypotheses will be processed in parallel, until a choice can be made between them. When the addressee encounters the indefinite article *a*, this will give access to the logical selection frame:

A Lsf: [[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Instance

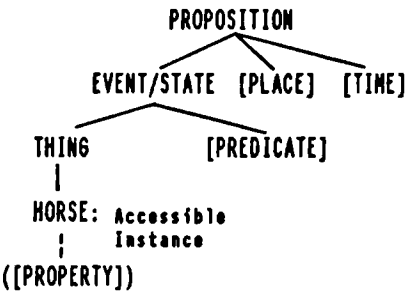
This logical selection frame shows both that an instance of a THING is following, and what that THING has to combine with to yield a PROPOSITION. Why then does the addressee go for the interpretation of the THING as the direct object, rather than as the subject of the second PROPOSITION? As we have seen, the addressee only uses information from both tiers of a logical selection frame if s/he has not got a logical hypothesis yet, or if the information in the lower tier cannot be fitted into the logical hypothesis. In this case, the lower tier yields the information that an instance of a THING is following. Although there is no THING slot in logical hypothesis 1, in logical hypothesis 2 there is a THING slot in which the instance of THING can be fitted. Because the indefinite article signals that an 'explicit' THING is following, and there is no comma to indicate that the first proposition is complete, there is no reason for the addressee

to assume that the THING signalled by the indefinite article should be taken as the beginning of the second proposition rather than as the THING following JOG.

Let us now look at why subjects get 'garden-pathed' with sentences like (5.5b), repeated here:

5.5b. The horse raced past the barn fell.

By the time the addressee encounters *raced*, s/he will have the logical hypothesis:



Raced will map onto a number of different concepts.[12] The past reading of (5.5b) will give access to the logical selection frame $RACE_1$:

$RACE_1$ Lsf: [[EVENT _] [PLACE] [TIME]]
PROPOSITION

[ACT [RACE [PATH]] ([MANNER]) ([PROPERTY*])]

The passive reading will give access to the logical selection frame $RACE_2$:

$RACE_2$ Lsf: [[STATE [THING] [PREDICATE BE [CIRCUMSTANTIAL _] [PLACE] [TIME]]
PROPOSITION PLACE

[CIRCUMSTANTIAL AT [ACT [RACE [PATH]] ([MANNER]) ([PROPERTY*])]
PLACE

In principle, the addressee has a choice between fitting $RACE_1$ into the PREDICATE slot in the logical hypothesis, and fitting $RACE_2$ into the PROPERTY slot in the logical hypothesis. However, the PREDICATE slot has to be filled with conceptual material in order to yield a PROPOSITION, while the PROPERTY slot is an optional slot. This means that the PREDICATE slot is accessible, while the PROPERTY slot only becomes accessible if the addressee recovers a concept which cannot be inserted into a slot which has to be filled in order to yield a proposition, or if assumptions in the context make the resulting interpretation relevant. In this case, the lower tier of the logical selection frame of $RACE_1$ can be inserted into a slot which has to be

filled in order to yield a proposition, and moreover, there are no assumptions in the context which make inserting $RACE_2$ in the PROPERTY slot of HORSE relevant, so that the addressee will choose the PREDICATE slot, rather than the PROPERTY slot.

What we see then is that we can define processing effort not only in relation to contexts, but also in relation to logical hypothesis formation and completion. In relation to context extension we saw that the fewer steps of context extension needed to yield an interpretation with adequate contextual effects, the smaller the processing effort; in relation to filling conceptual slots in a logical hypothesis we saw that the more accessible a conceptual slot, the smaller the processing effort involved in recovering it. In actual utterance interpretation, the amount of processing effort involved in computing an interpretation will depend on the interaction of these different processes.

5.2.2. Multiple centre-embedded sentences.

Different explanations have been proposed to account for the difficulty of processing multiple centre-embedded sentences like:

5.7. The rat the cat the dog bit chased ran away.

For example, Kimball (1973) proposed seven parsing principles, one of which, the principle of New Nodes, explained why deletion of complementizers can make sentences difficult to understand: the complementizer signals that a new phrasal node should be started. However, the difficulty in processing sentences like (5.7) does not seem to be due to the absence of complementizers. As we saw in chapter 1, Newmeyer (1983) points out that multiple centre-embedded constructions, with complementizers, are unacceptable:

5.8. The cheese that the rat that the cat chased ate was rotten.

Newmeyer argues that we can explain the unacceptability of multiple centre-embedded sentences by combining the competence model of generative grammar with a model of immediate memory storage. However, this proposal does not give us an explanation of why the sentences in (5.7) and (5.8) are unacceptable, while the sentence in (5.9) is fine, even though it has the same multiple centre-embedded structure:

5.9. The game those boys I met invented resembles chess.[13]

Moreover, it does not give us an explanation of why there is a gradient of unacceptability, so that (5.10) is more unacceptable than (5.7) and (5.8) even though it involves less words:

5.10. Oysters oysters oysters split split split.[13]

Smith (1989) proposes that the differences in processing difficulty of these sentences is due to *"the repetition of structurally undifferentiated phrases whose relations are therefore opaque."* (Smith, 1989, p.58). In other words, whereas the NPs *the game* and *those boys* in (5.9) differ in number, and the third NP is a pronoun, in (5.7) we have three NPs of the same structure, and in (5.10) we have three identical NPs. Similarly, in (5.9) we have three different VPs, while in (5.10) we have three identical ones. Smith says that because of this *"the human processing mechanism is too confused to cope."* (op.cit., p.58). However, this does not explain why the processing mechanism would be "too confused to cope", and moreover, it cannot be the whole story, because although (5.11) may be more difficult to process than (5.9), it still seems easier than (5.7):

5.11. The game the boy the girl met invented resembles chess.

Given that there is a gradient of acceptability for multiple centre-embedded sentences, it cannot be due to the structure of these sentences, nor to the structure of the constituents, nor to limitations of immediate memory storage, that some of these sentences are difficult or impossible to process. Smith says that another difference between (5.9) and (5.10) is that whereas in (5.10) we have three identical VPs which moreover are ambiguous between a transitive and an intransitive reading, (5.9) involves VPs which are "*of radically different meaning and involve no ambiguity ...*" (op. cit., p.58). However, just like *split, meet* is ambiguous between (at least) a transitive and an intransitive reading, while (5.9) is still easier to process than (5.7) in which none of the verbs has this ambiguity. Nor does reference to differences in verb meaning by itself give us an explanation, because the verbs in (5.7) are quite different in meaning, but this does not seem to make processing easier.

We can explain this phenomenon by looking at what is involved in the interpretation of these different sentences, i.e. how the addressee recovers 'who did what to whom'. It turns out that the concepts referred to in the different sentences constrain the interpretation to a greater or lesser extent. let us consider (5.7), repeated here:

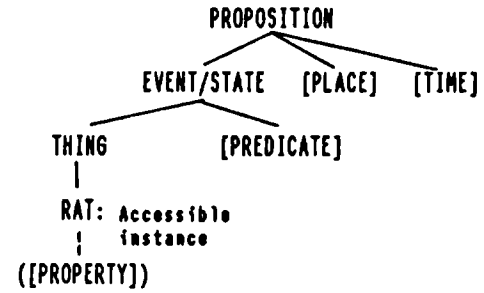
5.7. The rat the cat the dog bit chased ran away.

On encountering *The* the addressee recovers the logical selection frame for THE:

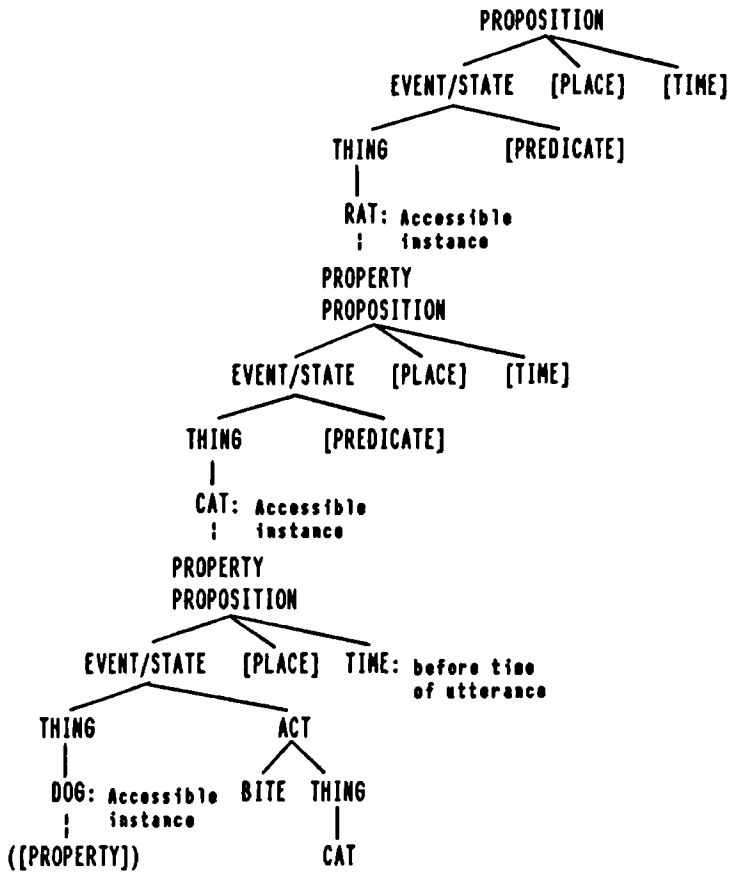
THE Lsf: [[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Individuation:
Accessible instance

The addressee then can set up a logical hypothesis into which RAT is fitted:



On encountering *the* again, the addressee recovers that an accessible instance of a THING is following. S/he does not find a THING slot in the logical hypothesis, so that s/he has to access the higher tier of the logical selection frame of THE, which shows how a PROPOSITION can be formed. Because RAT can take a PROPOSITION as a PROPERTY, this information can be fitted into the logical hypothesis, into which CAT then can be fitted; this process is repeated on encountering *the dog*, while BITE will be fitted in the most recently postulated PREDICATE slot. The THING slot following BITE in the logical hypothesis can be filled by CAT, as the CAT is most accessible THING, by virtue of the PROPOSITION being a PROPERTY of the CAT, yielding the following logical hypothesis:



This logical hypothesis presents the addressee with a number of problems. The addressee is faced with finding or setting up referents for the 'accessible instances' of RAT, CAT and DOG. The PROPERTY modifying RAT should help the addressee pick out the intended referent, but since that PROPERTY itself contains an accessible instance of CAT, finding a referent for RAT becomes dependent on finding a referent for CAT. This is repeated in that the PROPERTY modifying CAT should help the addressee pick out the intended referent, but since that PROPERTY itself contains an accessible instance of DOG, finding a referent for CAT is made dependent on finding a referent for DOG. There is no dog in the context, nor does accessing the encyclopaedic entries of RAT, CAT, and DOG yield any accessible dog, so that the addressee cannot find any referent.

On encountering *chased*, the addressee has two PREDICATE slots available into which the concept could be fitted, both of which are equally accessible. Encyclopaedic entries of the concepts encountered do not constrain the interpretation: it could equally well be the cat as the rat who did the chasing, and it could even be the dog, performing a number of different actions. Moreover, the cat, the rat and the dog could all be chased. When the addressee encounters *ran away*, this could again apply equally well to the cat as the rat, and

again encyclopaedic entries of the concepts involved do not constrain the interpretation. What we see then is that it is not due to the repetition of structurally undifferentiated phrases that the human processor is too confused to cope, as Smith (1989) proposes, but rather that this is due to there not being any basis on which to decide what reference should be assigned to the different animals, and to there not being any basis on which to decide what concepts should go where in the logical hypothesis.

When we compare this with the interpretation of (5.9), repeated here, a different picture emerges:

5.9. The game those boys I met invented resembles chess.

Building a logical hypothesis for (5.9) occurs along the same lines as for (5.7). The addressee is faced with similar problems as in processing (5.7), in that s/he has to find or set up a referent for GAME. The PROPERTY modifying GAME should help the addressee pick out the intended referent, but since that PROPERTY itself contains BOYS, finding a referent for GAME becomes dependent on finding referents for BOYS. However, from this stage the interpretation of (5.9) differs from that of (5.7). The PROPERTY modifying BOYS should help the addressee pick out the intended referent, and in this case the PROPERTY does constrain the interpretation of BOYS. In the first place, *I* maps onto a THING which is constrained by it being the communicator. This means that even when (5.9) is processed in isolation, the addressee can set up a (partial) conceptual representation for the THING. Moreover, *meet* can be easily disambiguated to MEET THING. Although again the THING could be either GAME or BOYS, the addressee can recover that games are not usually met by anyone, but that people are, so that the indeterminacy can be resolved in favour of BOYS. This means that the addressee now has a constraint on the interpretation of BOYS, namely that the BOYS at stake are boys that the communicator met. When INVENT THING is encountered, there are two PREDICATE slots available into which it could be fitted, and a filler for THING has to be found. However, the addressee can easily recover that people are not usually invented, but that they do invent things or ideas, so that the indeterminacy can be resolved in favour of BOYS INVENT GAME. This in turn gives the addressee a constraint on the interpretation of GAME, namely that the GAME at stake is a game invented by the boys that the communicator met. When RESEMBLE THING is recovered, there is only one PREDICATE slot left into which it can be fitted, which yields $GAME_i$

RESEMBLES THING, and this hypothesis is confirmed by CHESS, since chess is a game as well.

What we see then is that we can account for the differences in processing difficulty of multiple centre-embedded sentences, by looking at how the kinds of concepts involved together with encyclopaedic information concerning those concepts help or hinder completion of the logical hypotheses into a propositional form.

5.2.3. Filler-gap dependencies.

A phenomenon that has to be accounted for in a theory of natural language comprehension is how sentences containing 'gaps' (empty positions) and 'fillers' (antecedents for these gaps) are processed. For example, in (5.12) *which people* is the antecedent for the empty position after *invite*, and in (5.13) the relative pronoun *who* is the antecedent for the empty position after *likes*:

5.12. Which people$_i$ did Peter invite ___$_i$ to the party?

5.13. I saw the man who$_i$ John likes ___$_i$.

Within linguistic theory, in particular GB theory, it is postulated that apart from the gaps in (5.12) and (5.13), there are other gaps, i.e. PRO as in (5.14), and NP-trace in, amongst others, passive constructions (5.15), and raising constructions (5.16):

5.14. Mary$_i$ decided PRO$_i$ to treat herself to a night on the town.

5.15. John$_i$ was hit ___$_i$ by the ball.

5.16. Peter$_i$ seems ___$_i$ to be ill.

Psycholinguistic research into filler-gap dependencies has mostly been concerned with Wh-gaps (including relative pronouns) and PRO (e.g. Clifton & Frazier, 1986; Crain & Fodor, 1985; Fodor, 1988; Frazier, Clifton & Randall, 1983), but work has also been reported on NP-trace (e.g. Bever & McElree, 1988; Frazier & Flores d'Arcais, 1989; McElree & Bever, 1989; Nicol & Swinney, 1989).

When we look at what the processor is faced with in assigning a filler to a gap, we can, in principle, distinguish a number of different processes. In the first place, the processor needs to recognize fillers and gaps; in the second place, the processor may consider whether a potential antecedent is an appropriate antecedent for the gap; and in the third place, the actual assignment has to take place.

In the literature, not much has been said about how fillers are recognized. Instead, research has been concerned with how gaps are recognized, and how fillers are assigned to gaps. This has lead to the proposal of strategies which assume that gap recognition is a unified process, i.e. that the processor will follow the same strategy for detecting gaps irrespective of the nature of the fillers and gaps involved. On the one hand, it has been proposed that gaps recognition is 'gap-driven', i.e. that gaps are only postulated when the processor predicts the occurrence of a phrase of a particular type, and lexical material is missing in the position where it should occur (e.g. Clifton & Frazier, 1986; Fodor, 1978; Frazier et al., 1983; Jackendoff & Cullicover, 1971). On the other hand, it has been proposed that gap recognition is 'filler-driven', i.e. that on encountering a filler the processor postulates that a gap of the appropriate type will follow (e.g. Frazier, 1987c; Frazier & Flores d'Arcais, 1989).

When we look at the fillers of the different kinds of gaps postulated, i.e. Wh-gap, PRO and NP-trace, we see that there is a difference between Wh-fillers and the other fillers in that the Wh-fillers are the only ones that have a specific form whereby they may be signalling to the processor that a gap is following, for example *which people* in (5.12), and *who* in (5.13). In contrast, when we look at the fillers in (5.14), (5.15), and (5.16), there is nothing that could tell the processor that a gap is following, since the NPs do not differ from NPs in sentences without a gap; for example compare (5.14) and (5.17):

5.14. Mary$_i$ decided PRO$_i$ to treat herself to a night on the town.

5.17. Mary decided that she would stay at home.

On the basis of this observation, one can conclude that a 'filler-driven' account is possible for the detection of Wh-gaps, but that no such account is possible for the detection of PRO and NP-trace.[15]

Nicol & Swinney (1989) present some experimental findings which support the view that postulating Wh-gaps is in fact 'filler-driven'. However, these findings rest on the assumption that *that* in sentences like (5.18) is a relative pronoun:

5.18. The book that Mary liked was expensive.

Nicol & Swinney assume that *that* is a relative pronoun without giving any justification for their assumption, but in the linguistic literature it has been pointed out that this analysis faces some problems (e.g. Radford, 1988; Van Riemsdijk & Williams, 1986). For

example, it has been pointed out that *that* cannot occur as the object of a proposition, as in (5.19a), while other relative pronouns can:

5.19a. *The girl with that I was talking ...
b. The girl with whom I was talking ...

In the GB theory literature, it has been proposed that *that* in relative clauses should be analyzed as a complementizer, rather than as a relative pronoun. On this view, there is an empty relative Wh element (O_i) in the relative clause which accounts for the Wh-gap:

5.20. The book [$_{C'}$ O_i that [$_{IP}$ Mary liked t_i]]

As a justification of this analysis, Radford (1988) points out that relative clauses containing an overt relative pronoun followed by a complementizer occurred in Old and Middle English, and are found in other languages. However, the analysis of *that* as a complementizer is not without problems either. According to GB principles, the analysis of *that* as a complementizer should make structures like (5.21) ungrammatical, while we find that they are perfectly acceptable:

5.21. The book [$_{C'}$ O_i that [$_{IP}$ t_i amused me]]

In order to account for the grammaticality of structures like (5.21), Pesetsky (1982) proposes a special rule which collapses the empty Wh element (O_i) and the complementizer into one constituent which inherits all the features of the empty Wh element, so that the structure in (5.21) is changed to (5.22):

5.22. The book [$_{CP}$ that$_i$ [$_{IP}$ t_i amused me]]

Haegeman (1991) says about this that:

> *"Pesetsky's rule captures the intuition that the element that [in examples like (5.22)] is not quite the ordinary complementizer but that it also acts like a relative pronoun ..."* (Haegeman, 1991, p.424).

However, what we end up with here is a structure in which *that* is indistinguishable from a relative pronoun. This means that even the analysis put forward by GB theory supports the view that *that* is interpreted as a relative pronoun, as is assumed by Nicol & Swinney (1989).[16]

As we saw in section (3.1.4), Nicol & Swinney (1989) discuss experiments by Nicol & Osterhout (1988), and Nicol (1988) in which reactivation patterns were examined in sentences containing relative pronoun *that* and gaps, such as in (5.18):

5.18a. That's the actress that the dentist from the new medical centre in town had invited * to go to the party.

b. That's the actress that the dentist from the new medical centre in town had planned * to go to the party with.

They found that there was priming for *actress* immediately following *planned* as well as following *invited*, even though *plan* can occur both with and without a direct object. Nicol (1988) conducted a follow-up study which contrasted 'quasi-intransitive' verbs like *plan* (which can appear transitively and intransitively), and true intransitives such as *hesitate*. This study shows that significant priming of the head of the relative (e.g. actress in (5.18)) always occurs after the 'quasi-intransitives', but not after the true intransitives.

These findings are incompatible with 'gap-driven' accounts of Wh-gap recognition, because such accounts predict that a gap is only postulated if the processor predicts the occurrence of a particular phrase, and then does not encounter any lexical material in the position where it should occur. On such accounts, priming should only occur after *to* in sentences like (5.18a), i.e. after the processor discovers that no overt object follows *invited*, and priming should not occur at all in sentences like (5.18b), because no object needs to follow *planned* and, in fact, animate objects cannot follow it. On the other hand, these findings are compatible with the view that the processor recognizes a Wh-filler as a filler, and postulates that a gap of the appropriate type will follow, so that it will immediately consider the assignment of the filler to any gap of the appropriate type that it encounters.

Nicol & Swinney (1989) also discuss a priming experiment reported by Swinney, Ford, Frauenfelder & Bresnan (1988), in which reacti-vation patterns were examined in sentences like (5.19):

5.19. The boxer$_i$ visited the doctor$_k$ that$_k$ the swimmer at the competition had *1 advised *2 him$_i$ *3 to see ___$_k$ about the injury.
(* = probe point).

Swinney et al. found that there was significant priming for *doctor* after *advised* even though it is followed by a lexical NP (*him*):

Priming scores (Lexical Decision RTs to Control Words Minus RTs to Semantically Related Words for Each Referent) at Each Probe Point

	Probe point		
Referent	1	2	3
Boxer	23	20	51*
Doctor	32	56*	42*
Swimmer	9	0	20

(* = significant priming). (Nicol & Swinney, 1989, p.13).

These findings are again incompatible with 'gap-driven' accounts of Wh-gap recognition. Because there is lexical material following *advised*, no priming of *doctor* should occur at probe point 2. On the other hand, if the processor recognizes a Wh-filler as such, and postulates that a gap of the appropriate type will follow, then it will immediately consider the assignment of the filler to any gap of the appropriate type that it encounters, which is reflected in these findings.[16]

Given the model proposed in this thesis, the process of recognizing Wh-fillers and gaps can be accounted for in a straightforward way, by looking at the logical selection frames of Wh-phrases. For example, *which* and *who* in Wh-questions give access to the logical selection frames:

WHICH Lsf: [PROPOSITION [] [THING] []]

[THING$_i$]
Instance from
set of THINGS$_i$

WHO Lsf: [PROPOSITION [] [THING] []]

[THING (- [PROPERTY])]
Person

The lower tiers in the logical selection frames put a constraint on the instance of THING that is at stake, while the upper tiers specify that in order to yield a PROPOSITION the THING has to occur as a constituent, and combine with other conceptual categories, without specifying what it combines with or where it occurs. This causes the processor to postulate that a PROPOSITION will follow in which the THING will have to be fitted, so that any THING slot that is postulated in the logical hypothesis will be considered as a possible gap into which the THING can be fitted.

Relative pronoun *that* has as a logical selection frame:

THAT Lsf: [PROPOSITION [] [THING$_i$] []]
PROPERTY OF THING$_i$

This selection frame specifies that a PROPERTY of a THING is following, which is a PROPOSITION in which that THING itself occurs, without specifying what it combines with or where it occurs. However, since the function of relative clauses is to help the addressee identify or set up a referent for a THING, the resulting PROPOSITION does not form part of the overall PROPOSITION that is being processed. Rather, because the resulting PROPOSITION is a PROPERTY of the THING at stake, it can be matched against, or represented as encyclopaedic information under the conceptual address of the THING at stake. This logical selection frame then causes the processor to postulate that a PROPOSITION will follow in which the THING will have to be fitted. The processor will first build this separate PROPOSITION, before continuing to build the overall PROPOSITION expressed by the utterance in which the relative clause occurs.

Because the fillers of PRO and NP-trace are not recognizable as such, no 'filler-driven' account can be proposed for how PRO and NP-trace are recognized. Frazier et al. (1983) and Clifton & Frazier (1986) follow Chomsky (1981) in assuming that infinitive phrases are analyzed as clauses which contain an empty subject position, referred to as PRO, so that as soon as the processor encounters the infinitive it will postulate that there is a PRO in need of a filler. However, Chierchia (1982, 1985) and Turner (1989) argue that this analysis of infinitives cannot be maintained, because analyzing the infinitive as a proposition with a missing subject position makes the wrong predictions. On the view that the infinitive in (5.20) is a proposition with an empty subject position, we would have to assign *John* as the missing subject:

5.20. John$_i$ wants PRO$_i$ to read a book.

If we take (5.20) as a premise, together with the premise in (5.21), the analysis in (5.20) predicts that the conclusion in (5.22) can be validly drawn from the two premises:

5.21. Bill wants what John wants.

5.22. Bill wants John to read a book.

We know that (5.22) is not a valid conclusion from the premises in (5.20) and (5.21). Rather, the conclusion we draw from these premises is (5.23):

5.23. Bill wants (Bill) to read a book.

Yet by postulating that PRO is the empty subject position in a proposition which is filled on-line, one cannot explain why this is the case.

To account for this, Chierchia (1982, 1985) and Turner (1989) propose that the infinitive is an argument, rather than a proposition in need of an argument. On the view that the infinitive is an argument of the verb, there is no empty argument position available in the logical form for a 'subject', so that the inference in (5.22) cannot be drawn. If the infinitive represents a proposition in need of an argument than that argument would have to be supplied in the logical form, which then would give rise to the inference in (5.22).

If PRO is not the empty subject position in a proposition, then the question arises whether PRO is recognized as a gap at all.

McElree & Bever (1989) present some experiments which show that PRO is in fact not postulated as a gap, when its (intuitive) position in the sentence is encountered. In these experiments McElree & Bever presented sentences like (5.24) to subjects:

5.24. The stern judge/ who met with the defence/ adamantly refused [PRO] to (P1)/ argue about the appeal. (P2)

Subjects were asked to read the sentences on a computer screen, in sections as denoted by the slashes in (5.24). At the points (P1) and (P2) subjects were presented with a probe word, drawn from the antecedent NP (e.g. *stern* in (5.24)), which remained on the screen until the subject had made a yes/no recognition judgment. McElree & Bever found that priming for PRO only occurs at the end of the sentence, P2, and not at the probe point immediately following the infinitive, P1. If a gap was postulated at this point, we would expect priming to occur.

It may be argued that PRO would only be postulated after the addressee encounters the actual verb, e.g. *argue* in (5.24). However, evidence that this is not the case comes from an experiment conducted by Osterhout and Nicol (1988). Using the cross-modal priming technique, the technique whereby sentences are presented auditorily, and subjects are asked to make a lexical decision on visually presented word/nonword targets, Osterhout & Nicol presented sentences like the following:

5.25a. The actress invited the dentist$_i$ from the new medical centre PRO$_i$ to *1 go to the pa*2rty at the *3 mayor's *4 house *5.

b. The actress$_i$ was invited by the dentist from the new medical centre PRO to *1 go to the pa*2rty at the *3 mayor's *4 house *5.
(* = probe point).

and obtained the following results:

Priming scores (Lexical Decision RTs to Control Words Minus RTs to Semantically Related Words for Each Referent) at Each Probe Point

	Probe point				
Referent	1	2	3	4	5
Test of materials of the type exemplified in sentence (5.25a)					
Actress	21	0	28	24	31@
Dentist	-10	15	37@	77@	6
Test of materials of the type exemplified in sentence (5.25b)					
Actress	19	-8	29	32@	40@
Dentist	19	31	48@	2	-3

(@ = significant priming).

If PRO were postulated immediately, then we would expect significant priming to occur at probe point 1. If it were postulated after the verb was encountered, we would expect significant priming to occur at probe point 2. However, this is not the case. We see that significant priming only occurs from point 3 onwards, which is 1,000 msec. downstream from probe point 1. These findings then again support the claim that PRO is not postulated as a gap on-line.

Not much work has been done to establish whether NP-trace following the passive and raising verbs is postulated as a gap on-line. However, McElree & Bever (1989) not only tested PRO in their experiments, but also tested NP-trace following passives and raising constructions, as postulated by GB theory. Again using the priming technique, they presented subjects with sentences involving the raising construction, like (5.26), and passive sentences like (5.27):

5.26. The stern judge/ who met with the defence/ is sure [t] to (P1)/ argue about the appeal. (P2)

5.27. The dazed cabbie/ who drove the beat-up taxi/ was resented [t] (P1)/ constantly. (P2)

McElree & Bever found that priming for NP-trace occurs only at the end of the sentence (probe point 2) for both sentence types, and not immediately following the trace (probe point 1). Again, if NP-trace were postulated as a gap on-line we would expect priming to take place at the first probe points in these sentences.

Because of the analysis of passives as involving movement of the object, it has been assumed that passives are more difficult to process

than actives, which seemed to be borne out by experimental evidence (e.g. Gough, 1965, 1966; Mehler, 1963). However, these experiments involved comprehension tasks which take place after the sentence as a whole has been processed, such as sentence-picture matching tasks, and therefore do not show whether passives are more difficult to process than actives on-line. In fact, Black, Nickels & Byng (1992) present data which suggests that in sentence-picture matching tasks, reversal errors are not due to on-line processing, but can be explained in terms of the off-line processes involved in the mapping from a conceptual representation onto pictures. Also, findings from Carrithers (1989) show that on-line processing of passives is not more difficult than actives.

If no gap is postulated on-line, as suggested by the findings of McElree & Bever (1989) then we can explain the finding that passives are not more difficult to process than actives on-line simply by postulating that building conceptual structures for both passives and actives proceeds along the same lines, without passives being transformed into an underlying 'active' structure. As we saw in section 4.3.2, Jackendoff proposes that *Be* maps onto a concept expressing THING BE PLACE, where the PLACE can be a physical PLACE, or a non-physical PLACE such as a temporal PLACE or an identificational PLACE. The passive will map onto a CIRCUMSTANTIAL PLACE, and expresses that the THING is in the circumstance defined by some other THING having acted on it (as proposed by Pinker (1990)).

If PRO and NP-trace are not postulated as gaps on-line, the question arises what it is they represent. Our interpretation of a sentence like (5.28) does involve working out whether it is Mary who is taken to be kind or whether the person referred to by *him* is taken to be kind, and there must be something that enables us to do this:

5.28. Mary asked him to be kind.

Fodor (1989) argues that it may be the case that PRO is rapidly interpreted although it does not give rise to rapid priming. She argues that this position might be possible if one assumes that PRO is present at S-structure, but only receives an interpretation at LF (as proposed by GB theory):

> *"Possibly, then, a sluggish response on the priming task, even after antecedent assignment, is characteristic of elements that are not assigned their antecedents at S-structure, regardless of whether they <u>exist</u> at S-structure"* (Fodor, 1989, p.205).

However, this does not explain why priming of other elements decreases after they have been interpreted, while priming would increase after PRO has been interpreted. If priming signifies activation in the case of Wh-fillers, then it should occur on activation of antecedents of PRO. Moreover, as Fodor herself points out, this proposal would give us no explanation of why NP-trace does not show immediate priming, since in GB theory NP-trace gets its interpretation at S-structure, rather than at logical form.

Chierchia (1982, 1985) argues that PRO represents semantic information. He proposes that this information is a matter of semantic entailments, which can be captured by meaning postulates.

Given the account of conceptual structure presented here, we can show why this would be the case, for both PRO and NP-trace. Because PRO and NP-trace are not postulated as gaps in conceptual structure, the infinitive and the passive cannot map onto STATES or EVENTS in conceptual structure, but rather map onto PREDICATES (which in the case of passives are circumstantial PLACES). PREDICATES differ from other conceptual categories in that they do not individuate concepts in the way the other conceptual categories do. PREDICATES can only be individuated as part of the concept in whose logical selection frame they occur, and consequently they get their interpretation from that concept.

In on-line comprehension, the processor's concern is to build a well-formed conceptual structure. When it encounters a PREDICATE slot, it will build a well-formed PREDICATE. In order to fully interpret the resulting PREDICATE, the whole STATE or EVENT expressed by the verb has to be taken into account. In the case of a subject-predicate structure, the structure of the logical form will match the semantic representation of the verb, and can be interpreted accordingly.

In the case of an infinitive and of a passive, the structure of the logical form does not match the semantic representation of the verb. In the case of the infinitive, the processor has to make an inference as to which THING the predication applies to, which can be stated separately as an implication of the logical form. On this view, the logical form does not itself contain a 'subject' for the infinitive, and therefore predicts that the right conclusion will be drawn in the case of (5.20) - (5.21), repeated here:

5.20. John wants to read a book.

5.21. Bill wants what John wants.

The passive expresses that a THING is in a CIRCUMSTANTIAL PLACE, which Pinker (1990) analyzes as expressing that *"X is in the circumstance defined by Y acting on it."* (Pinker, 1990, p.134). The structure of this CIRCUMSTANTIAL PLACE again does not match the semantic representation of the verb, which means that in order to fully interpret the PROPOSITION, the addressee has to draw the inference as to what caused the THING to be in the circumstance expressed by the CIRCUMSTANTIAL PLACE. Because the THING is the affected entity, the addressee can easily draw the inference that some other THING acted on it in the way expressed by the verb. This inference can then be represented as an implication of the PROPOSITION.

In the literature, it is generally assumed that the assignment of an antecedent to a gap is accomplished immediately, as soon as the gap is postulated. However, when we consider what is involved in 'gap-filling', we can, in principle, distinguish between two different processes. In the first place, when a gap is encountered the processor may consider whether a potential antecedent is an appropriate antecedent for the gap; and in the second place, the actual assignment has to take place. If the processor went straight from encountering a gap to assigning a filler to it, some structures would always be inherently more difficult to process than others because they would always involve reanalysis.

In contrast, Relevance theory considerations would lead one to expect that the first process plays an important role in processing filler-gap dependencies. One would expect that if the processor has a choice about whether to assign a filler to a gap or not (e.g. in the case of an ambiguous verb), the filler would only actually be assigned to a gap, if the assignment gives rise to an interpretation in accordance with the principle of Relevance.

Frazier, Clifton & Randall (1983), and Clifton & Frazier (1986) propose the Most Recent Filler Strategy (MRFS). This strategy says that:

> *"During language comprehension a detected gap is initially and quickly taken to be co-indexed with the most recent potential filler."* (Frazier et al., 1983, p.196).

They propose this strategy to account for the finding that readers take less time to process sentences like (5.29a) than sentences like (5.29b):

5.29a. Who$_i$ could the girl have begged (PRO) to sing for ___$_i$?

b. Who$_i$ could the girl have begged ___$_i$ (PRO) to sing?

Frazier et al. and Clifton & Frazier argue that for sentences like (5.29a) a reader following the MRFS will appropriately assign *the girl* to PRO, and then *who* to the gap after *for*. A reader applying this strategy to sentences like (5.29b) will again assign *the girl* to the PRO, but then not find a gap to assign *who* to. Because this is an obligatory filler, reanalysis has to take place. This will take time, and therefore sentences like (5.29b) will take longer to understand. Because of these findings, Frazier et al. called sentences like (5.29a) 'recent filler' (RF) sentences, and sentences like (5.29b) 'distant filler' (DF) sentences.

However, the explanation proposed by Frazier et al., and Clifton & Frazier rests on two assumptions: in the first place, it is assumed that PRO is postulated as a gap on-line, and in the second place, it is assumed that verb subcategorization frames become available according to Lexical Preference. As we have seen above, neither of these assumptions can be maintained. Without these assumptions, the MRFS in fact predicts that sentences like (5.29a) take longer to process than sentences like (5.29b). Given that a gap will be postulated after any potentially transitive verb (cf. Nicol, 1988), a gap will be postulated following *begged*, to which, according to the MRFS, *who* will be assigned. This turns out to be the correct assignment for (29b), but in (29a) this would lead to reanalysis when the gap after *for* is encountered.

A 'filler-driven' account of the assignments of fillers to gaps is proposed by Frazier (1987c), and by Frazier & Flores d'Arcais (1989). Frazier & Flores d'Arcais formulate their proposed strategy as follows:

> *"Active filler strategy. Assign an identified filler as soon as possible; i.e., rank the option of a gap above the option of a lexical noun phrase within the domain of an identified filler."* (Frazier & Flores d'Arcais, 1989, p.332).

Frazier & Flores d'Arcais go on to demonstrate how this strategy is employed in processing (5.30):

5.30. Who did John see Sylvia with ___?

On encountering *who*, the addressee will assign it to the subject position, but will reject this analysis when John is encountered. The processor will then postulate a gap following *see* and assign *who* to this gap. This analysis will be rejected when *Sylvia* is recognized.

When the gap after *with* is encountered, the processor will assign *who* to this gap, and since no more lexical material follows, this will turn out the right assignment. However, this proposal goes against the finding, referred to by Frazier (1987b), that (5.31a) has as a preferred interpretation (5.31b), rather than (5.31c):

5.31a. Which patient did the nurse bring the doctor?

b. Which patient did the nurse bring the doctor ___?

c. Which patient did the nurse bring ___ the doctor?

According to the 'Active filler strategy', the option of a gap will be ranked above the option of a lexical noun phrase, so that one would expect that when the processor recovers *bring*, it postulates that two gaps will be following, and assigns the 'filler' to the first gap, which would give one the reading in (5.31c), which is the unpreferred reading.

Frazier (1987b) says that the assumption that a filler is assigned to a gap immediately is supported by several indirect sources of evidence. However, when we look at which sources she actually refers to, we find Frazier et al. (1983), the first paper in which the Most Recent Filler Strategy was proposed. In this paper no evidence is presented for the assumption that a filler is assigned to a gap immediately, but rather the interpretation of the findings rests on this assumption. A second source of indirect evidence referred to by Frazier is Crain & Fodor (1985), who propose an alternative explanation for the Recent filler/Distant filler phenomenon. Again, this explanation rests on the assumption that antecedents are immediately assigned to Wh-gaps, rather than providing evidence for this. Other evidence that Frazier refers to includes Tanenhaus et al. (1985), on lexical preference, in which the evidence for lexical preference and for immediate filling of gaps are mutually dependent.

Garnsey, Tanenhaus & Chapman (1989) report on some experiments which show reactivation of the antecedent at the Wh-gap, regardless of whether the antecedent is pragmatically plausible or implausible. Garnsey et al. measured evoked brain potentials of their subjects while they read sentences containing Wh-gaps, such as:

5.32a. The businessman knew which customer the secretary called ___ at home.

b. The businessman knew which article the secretary called ___ at home.

They found that the implausibility of an antecedent (as in (5.32b)) gives rise to a particular evoked potential pattern (N400), whereas the plausible antecedent (as in (5.32a)) does not give rise to this pattern. Tanenhaus, Boland, Garnsey and Carlson (1989) refer to these experiments as evidence for immediate filling of the Wh-gap. However, Garnsey et al. (1989) explicitly state that:

> *"It is important to realize that N400 is not a direct reflection of gap filling. It is instead the reflection of the incongruity that is a consequence of making an implausible filler-gap assignment in these sentences. In fact, it is possible that N400 arises not as a consequence of actually filling the gap but rather merely of evaluating the possibility of the filler-gap assignment."* (Garnsey et al., 1989, p.58).

Tanenhaus et al. (1989) present some findings concerning the assignment of fillers to Wh-gaps, which support the view that fillers are not immediately assigned to gaps. They report on a 'make sense' reaction time measuring experiment, involving sentences like the following:

5.33a. The district attorney found out which witness the reporter asked ___ about the meeting. (Early gap).

b. The district attorney found out which witness the reporter asked anxiously about. (Late gap).

On the view that a filler is immediately assigned to a gap, one would expect that in the 'Late gap' sentences *which witness* would have been assigned erroneously to the gap after *asked*, so that when the gap after *about* is encountered, reanalysis would have to take place. On the assumption that reanalysis takes time, we then would expect the 'Late gap' sentences to take longer than the 'Early' gap sentences. However, Tanenhaus et al. found that the 'Late gap' sentences actually take less time (4.539 msec.) than the 'Early gap' sentences (4.623 msec.). As an explanation for this they suggest that there is little cost associated with reassigning a filler. Although this may be a possible explanation, even if there is little cost associated with reassigning a filler, we would not expect the 'Late gap' sentences to actually involve less time than the 'Early gap' sentences. This leaves the findings open for an alternative explanation, i.e. that the processor considers possible gaps without immediately assigning the filler to the first encountered gap. There is, therefore, no experimental evidence which directly supports the claim that fillers are assigned to gaps immediately on encountering them, while the

findings of Tanenhaus et al. support the proposal that a distinction should be made between the consideration of a filler–gap assignment and the actual assignment.

Given the model proposed in this thesis, we can account for the assignment of fillers to gaps in a straightforward way. In the case of WH-questions and relative clauses containing a relative pronoun, the logical selection frame of the Wh-element will specify what logical hypothesis should be built. Moreover, it specifies that the Wh-phrase should be incorporated in the logical hypothesis. Let us look at how this is done in the case of (5.12), repeated here:

5.12. Which people$_i$ did Peter invite ___$_i$ to the party?

Which in (5.12) gives access to the logical selection frame:

WHICH Lsf: [PROPOSITION [] [THING] []]

[THING$_i$]
Instance from
set of THINGS$_i$

This means that when an addressee accesses this logical selection frame, s/he can built the logical hypothesis that a PROPOSITION is following in which the THING occurs. When *people* is recognized it can be fitted into the THING slot. Then when auxiliary *did* is recognized, it will give access to the logical selection frame:

DO Lsf: [PROPOSITION [EVENT [THING] [_]] [PLACE] [TIME]]

[PREDICATE]

This logical selection frame shows that DO does not itself occur as a constituent in conceptual structure, but merely signals that a concept of the category PREDICATE is following, and what this PREDICATE has to combine with to yield a PROPOSITION. Because the addressee only has the logical hypothesis that a PROPOSITION is following in which PEOPLE occurs, s/he will access the whole selection frame of DO, which yields a logical hypothesis concerning the structure of the PROPOSITION. It can then be considered whether PEOPLE could appropriately be assigned to the THING slot. However, when *Peter* is recognized, the addressee recovers that it is a THING, which has to be fitted in the logical hypothesis. By assigning PEOPLE to the THING slot, the addressee would not be able to integrate PETER into the logical hypothesis. By assigning PETER to the THING slot, on the other hand, the addressee retains the hypothesis that PEOPLE will be fitted into the PROPOSITION somewhere. This means that the assignment

of PETER to the THING slot is the only assignment possible given the logical hypothesis. Then, when *invite* is encountered, the addressee can build the logical hypothesis that a THING is following, and can then consider whether PEOPLE could appropriately be assigned to this THING slot. The possibility of this assignment is supported by the assumption that people invite people to social occasions. When the addressee encounters TO PARTY, PEOPLE can actually be assigned to the THING slot, because there are no other potential fillers, and the THING cannot be left implicit.

Let us now look at (5.31a), repeated here with its preferred reading (5.31b) and unpreferred reading (5.31c):

5.31a. Which patient did the nurse bring the doctor?

b. Which patient did the nurse bring the doctor ___?

c. Which patient did the nurse bring ___ the doctor?

When processing (5.31a), the addressee builds logical hypotheses in the same way as for (5.12). On encountering *bring*, this will map onto a number of different concepts, giving rise to a number of different logical hypotheses. The one that is borne out by the rest of the sentence has two THING slots available. The question then is why the addressee goes for the assignment of DOCTOR to the first THING slot and PATIENT to the second THING slot, rather than the other way around. It turns out that this assignment is not due to any strategy for assigning fillers to gaps, but rather that it is due to the meaning of the verb *bring*. On both dative readings ([_ NP PP] and [_ NP NP]), *bring* implies movement towards a PLACE or THING, from the perspective of that PLACE or THING, i.e. it implies 'coming to where the place/thing is' (rather than 'going somewhere'). To illustrate this, it is fine to say (5.34) to the parents of your friend, before going out, but it is odd to say (5.35) to your friend, when you are in the pub:

5.34. I'll bring him home at eleven.

5.35. ?? We can have one more drink, and then I'll bring you home.

Example (5.34) is uttered to the parents, and bringing your friend home involves movement towards the parents, so that the goal of the movement coincides with where the parents are or will be. Example (5.35) on the other hand, is uttered in a pub, so that getting your friend home involves movement away from the pub to somewhere else. Using *bring* in (5.35) then gives rise to a clash between the perspective of moving

away from a place to somewhere else and the perspective of coming to a particular place, which makes it an odd utterance. What this means is that by using *bring*, the communicator communicates that the main relevance of the utterance does not lie in where a thing is brought to by someone, but rather that the PLACE or THING that something is brought to is already in the immediately accessible context, and in turn gives access to a context in which the utterance will be relevant. This explains why the sentences in (5.36a) seem odd, while the sentences in (5.36b) are fine[17]:

5.36a. ? The nurse brought a doctor the patient.
? The nurse brought a doctor a patient.
? The nurse brought the patient to a doctor.
? The nurse brought a patient to a doctor.

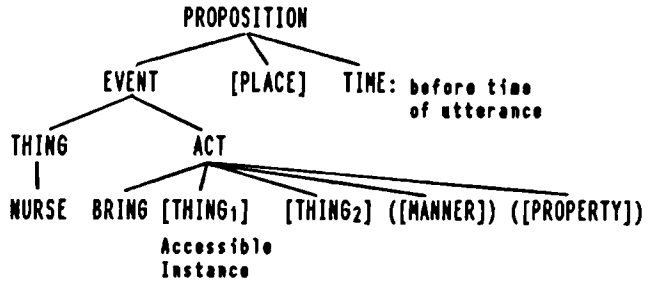
b. The nurse brought the doctor a patient.
The nurse brought the doctor the patient.
The nurse brought a patient to the doctor
The nurse brought the patient to the doctor.

Bring communicates that the goal is already in the immediately accessible context, which is confirmed by the use of the definite article in the (b) sentences, which communicates that an accessible instance of DOCTOR is at stake. In the (a) sentences, on the other hand, there is a clash between the information communicated by *bring* and the information communicated by the indefinite article, which merely says that some instance of DOCTOR is at stake. Since the addressee has no way of knowing which instance is intended, s/he cannot interpret the action from the perspective of the instance of DOCTOR.

This can explain why (5.31a), has (5.31b) as a preferred reading rather than (5.31c):

5.31a. Which patient did the nurse bring the doctor?
b. Which patient did the nurse bring the doctor ___?
c. Which patient did the nurse bring ___ the doctor?

When encountering *bring* in (5.31a), this will map onto a number of different concepts, giving rise to a number of different logical hypotheses, one of which is:



This hypothesis will cause the addressee to consider whether PATIENT is a possible filler for either of the THING slots. However, when *the* and *doctor* are recognized, the addressee recovers that an accessible instance of DOCTOR will follow. Because PATIENT is not an accessible instance, the only assignment that is compatible with this logical hypothesis is the assignment of DOCTOR to the $THING_1$ slot and PATIENT to the $THING_2$ slot.[18]

As we saw above, Frazier et al. (1983) and Clifton & Frazier (1986) found that readers take less time to comprehend 'recent filler' sentences like (5.29a), than 'distant filler' sentences like (5.29b), repeated here:

5.29a. Who$_i$ could the girl have begged to sing for ___$_i$?

b. Who$_i$ could the girl have begged ___$_i$ to sing?

In order to account for this, they proposed the Most Recent Filler Strategy. However, as we saw above, the view that a Most Recent Filler Strategy is used in assigning fillers to gaps cannot be maintained. How then can we account for these findings? When encountering *who* in the sentences in (5.29), this gives access to the logical selection frame:

WHO Lsf: [PROPOSITION [] [THING] []]

[THING (- [PROPERTY])]
Person

The processor then builds the logical hypothesis that a PROPOSITION is following, into which the THING has to be fitted. One could postulate that the processor notes the gap after BEGGED but does not immediately assign the THING to it. Then when the gap after FOR in (5.29a) is encountered without any further lexical material, the processor assigns the THING to this gap. In (5.29b), no further gap is found, so that the processor has to back-track to assign the THING to the gap after BEGGED. One could then postulate that the increased processing time is due to this back-tracking. However, Frazier et al. (1983), and Clifton & Frazier (1986) also found that a similar difference in

comprehension time is obtained when the ambiguous verb *beg* is replaced by unambiguous control verbs like *force* and *try*, so that sentences like (5.37a) take less time to understand than sentences like (5.37b):

5.37a. Who$_i$ could the girl have tried to sing for ___$_i$?
Subject control (RF)

b. Who$_i$ could the girl have forced ___$_i$ to sing?
Object control (DF)

Since there is no constraint on the interpretation of the THING following FORCE it cannot be left implicit, which means that the THING referred to by WHO has to be assigned to this THING slot. This would have as a consequence that no back-tracking would take place, so that sentences like (5.37b) should not take longer to process than 'recent filler' sentences. Since they do take longer to process, this explanation cannot be correct. However, as in order to fully interpret an utterance containing an infinitive the addressee has to draw an inference as to which THING the predication expressed by the infinitive applies to, and it turns out that for an explanation of the findings, we have to look at what is involved in drawing the inference as to who SING is predicated of.

MacWhinney (1977, 1982) found that perspective maintenance or change influences the ease of processing for languages like English and German, and MacWhinney & Pleh (1988) found the same in a study of Hungarian. In experiments involving sentences with relative clauses, they found that processing sentences was easiest (leading to least error rates and fastest reaction times) when the subject of the main clause was also the subject of the relative clause:

5.38. The boy who sees the girl chases the policeman. (SS)

more difficult when the object of the main clause was the subject or the object of the relative clause:

5.39. The boy chases the girl who sees the policeman. (OS)

5.40. The boy chases the girl who the policeman sees. (OO)

and most difficult when the subject of the main clause was the object of the relative clause:

5.41. The boy who the girl sees chases the policeman. (SO).

Although the 'recent filler/distant filler' sentences do not contain relative clauses, we see that in drawing the inferences for the different sentences, processing times reflect the findings from

MacWhinney & Pleh: in processing the 'recent filler' sentences the perspective is maintained in that the subject of the 'recent filler' sentence is also the subject of the inference, while the perspective is changed in processing the 'distance filler' sentences, in that the object of the 'distant filler' sentence is the subject of the inference. The question then is why this change in perspective would give rise to increased processing time. In the case of RF and DF sentences such as those in (5.37):

5.37a. Who$_i$ could the girl have tried to sing for ___$_i$?

5.37b. Who$_i$ could the girl have forced ___$_i$ to sing?

we see that when perspective is maintained no new information about the referent of *who* is added when the inference is made, i.e. in principle the referent of *who* should be recoverable from the relevant encyclopaedic information stored under GIRL. In the case of a change in perspective, we see that the inference adds new information about the referent of *who*, namely that the singing is predicated of the referent of *who*. This means that in the case of distant filler sentences the addressee will not only access encyclopaedic information stored under GIRL, but also encyclopaedic information concerning people singing. This means that in the case of distant filler sentences, the context is extended further than in the case of recent filler sentences, which, as we saw in section (5.2.1) increases processing effort, because each time the context is extended by one step processing effort increases.

5.3. Issues of acceptability.

In the psycholinguistic literature, it is generally assumed that particular structures are ruled out because of a grammatical rule or constraint. This has meant that although quite some work has been done in psycholinguistics concerning the assignment of fillers to gaps, no experiments have been conducted concerning the processing of ill-formed sentences such as (5.42) - (5.44):

5.42. Who did Sue see the dog that bit ___?

5.43. Who did John believe the claim that Ann saw ___ ?

5.44. Who did Mary think that ___ came?

It is generally assumed that no functional (processing) explanation is possible for the unacceptability of these sentences. For example, it cannot be the case that the unacceptability is due to the distance

between the filler and the gap, putting too much strain on memory, because in a sentence like (5.45) the distance between filler and gap is much greater than in any of the above sentences, but it is perfectly acceptable:

5.45. Who did John tell Ann and Sue that Bill had fallen in love with ___?

This has led to the conclusion that the unacceptability of the sentences above must be due to syntactic constraints. However, as Kempson & Matthews (1987) point out, there are variations in how bad the different structures are judged to be. On the view that these structures are unacceptable simply because they are ungrammatical, one would expect that there would be no gradability in how unacceptable they are, because there is no gradability in the concept of grammaticality. In order to account for this, Kempson & Matthews (1987), and Kempson (1988b) propose that the constraints which are violated operate over the construction of propositional forms, and that differences in acceptability are due to how easily an ill-formed logical form can be rectified to yield a well-formed logical form. However, the proposal that the unacceptability of these structure is due to constraints (either operating over linguistic or logical form) raises the question of why these constraints exist. Newmeyer (1983) argues that:

> "*There are enough examples of constraint-violating sentences that seem (intuitively) to present processing difficulties that it seems reasonable to assume that constraints arose historically to facilitate the production and comprehension of sentences. But what has apparently happened is that, in the course of time, the processing-derived constraints have taken on a grammatical "life of their own", so to speak. Now some constraints do seem to have a confusion-reducing effect and some seem not to. But whether they have this effect or not, they have one fundamental property in common: their formulation involves such notions as "syntactic category" and "constituent structure" - that is, their formulation is in terms of the primitives of grammatical theory.*" (Newmeyer, 1983, p.109).

However, this explanation raises a new question, namely why constraints that started out to facilitate processing, changed to take on a grammatical "life of their own". This proposal seems to imply that somewhere along the way the link between grammar and processing was lost.

Given the model proposed here, it turns out that we do not have to propose any special constraints to account for why the sentences in (5.42)-(5.44) are judged unacceptable, rather there unacceptability follows from the fact that the logical selection frames of the concepts involved either cannot be integrated into the logical hypothesis, or induce the wrong logical hypothesis. To show why this is the case let us look what happens when (5.42) is processed:

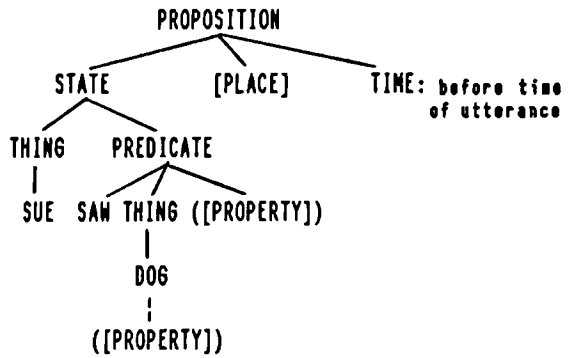
5.42. Who did Sue see the dog that bit ___?

On encountering *who*, the addressee accesses the logical selection frame:

WHO Lsf: [PROPOSITION [] [THING] []]

[THING (- [PROPERTY])]
Person

This causes the addressee to postulate that a PROPOSITION will follow in which the THING has to be integrated. By the time that the addressee encounters *that*, she has the following logical hypothesis:



In this logical hypothesis there is no THING slot into which the THING can be fitted. On encountering *that*, this maps onto a number of different concepts, which give access to a number of different logical selection frames. Complementizer *that* gives access to the logical selection frame:

THAT$_1$ Lsf: [[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[(THING) PROPOSITION]

Demonstrative *that* gives access to the logical selection frame:

THAT$_2$ Lsf: [[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Accessible instance at PLACE
away from communicator

This logical selection frame specifies that the THING is in a PLACE away from the communicator, which can be interpreted in different semantic fields, e.g. a physical PLACE or a temporal PLACE.

Relative pronoun *that* gives access to the logical selection frame:

THAT$_3$ Lsf: [PROPOSITION [] [THING$_i$] []]
PROPERTY OF THING$_i$

Since DOG has just been fitted into the logical hypothesis, the logical selection frame of relative pronoun *that* can be fitted into the logical hypothesis. This logical selection frame causes the addressee to postulate that a PROPOSITION will follow in which DOG will occur. However, as we saw in section (5.2.3), since the function of relative clauses is to help the addressee identify or set up a referent for a THING, the resulting PROPOSITION does not form part of the overall PROPOSITION that is being processed. Rather, the resulting PROPOSITION is a PROPERTY of the THING at stake, which is represented under the conceptual address of the THING at stake. This logical selection frame then causes the processor to postulate that a PROPOSITION will follow in which the THING will have to be fitted. The processor will first build this separate PROPOSITION, before continuing to build the overall PROPOSITION expressed by the utterance in which the relative clause occurs. Because the logical selection frame of WHO specified that the THING is part of the overall PROPOSITION expressed by the utterance, looking for a THING slot in which it can be fitted will be postponed until the processor resumes building the overall PROPOSITION expressed by the utterance. This means that when the THING slot following BITE is encountered, the THING referred to by *who* is not available as a filler. Encyclopaedic information might cause the addressee to postulate that a THING of the type PEOPLE is at stake (as in: *watch out, that dog bites!*). However, since there is no further lexical material following, the addressee ends up with a logical hypothesis about the overall PROPOSITION expressed by the utterance, in which there is no THING slot into which the THING referred to by *who* can be fitted, so that no complete PROPOSITION can be computed.

When we look at what happens when (5.43) is processed, it turns out that its unacceptability again is due to the addressee's inability to compute a complete PROPOSITION:

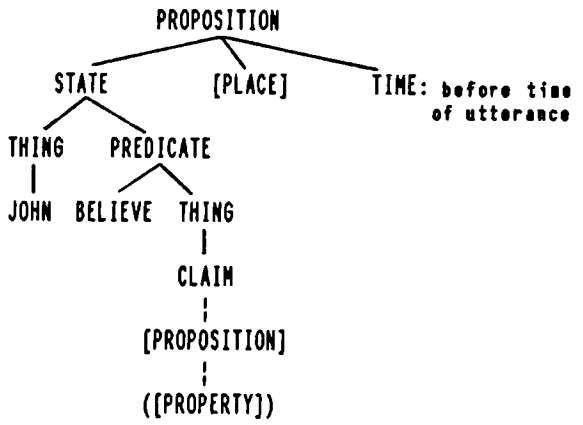
5.43. Who did John believe the claim that Ann saw ___ ?

When we look at the meaning of *the claim that Ann saw someone*, we see that *that Ann saw someone* does not express a PROPERTY of *the claim*, but rather that it expresses what the claim is. In other words, the concept CLAIM here is a THING which is a thought, i.e. a PROPOSITION, about which a propositional attitude is expressed. CLAIM then functions as a THING in conceptual structure, but the addressee recovers that it is used to refer to a PROPOSITION. This means that CLAIM has as a logical selection frame:

CLAIM Lsf: [[EVENT/STATE [THING _] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING CLAIM - [PROPOSITION] (- [PROPERTY])]
some
individuation

When the addressee encounters *that* in (5.39), she has the following logical hypothesis available:

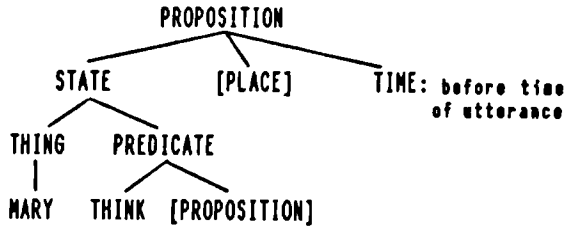


In this logical hypothesis there is no THING slot available in which the THING referred to by *who* can be fitted. *That* maps onto different concepts which give access to different logical selection frames, as set out above. The logical selection frame of complementizer *that* can be taken as signalling that the PROPOSITION referred to by CLAIM is following, and the logical selection frame of relative pronoun *that* can be taken as signalling that a PROPERTY of CLAIM is following. However, these logical selection frames cannot be integrated in the overall PROPOSITION, so that there is no THING slot available for the THING referred to by *who*. This again means that no complete PROPOSITION can be computed.

When we look at how (5.44) is processed, it turns out that the unacceptability is caused by the addressee being momentarily garden-pathed.

5.44. Who did Mary think that ___ came?

By the time the addressee encounters *that*, s/he has the logical hypothesis:



In this hypothesis no THING slot is available into which the THING referred to by *who* can be fitted, so that the addressee maintains the hypothesis that the THING will be fitted somewhere in the PROPOSITION. As set out above, *that* maps onto different concepts that give access to different logical selection frames:

THAT$_1$ Lsf: [[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

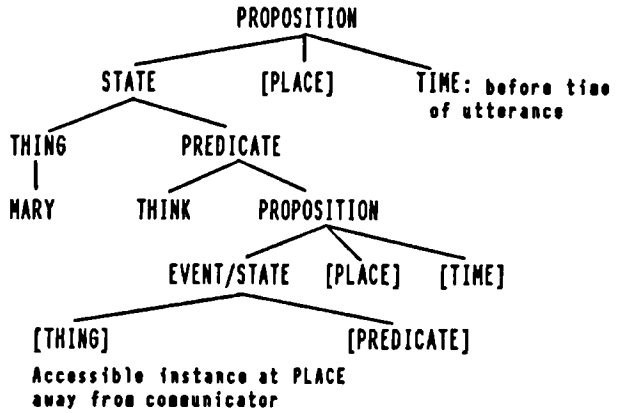
[(THING) PROPOSITION]

THAT$_2$ Lsf: [[EVENT/STATE [THING] [PREDICATE]] [PLACE] [TIME]]
PROPOSITION

[THING]
Accessible instance at PLACE
away from communicator

THAT$_3$ Lsf: [PROPOSITION [] [THING$_i$] []]
PROPERTY OF THING$_i$

THAT$_3$ will be discarded because there is no PROPERTY slot accompanying an accessible THING. The selection frame of THAT$_1$ yields the information that a PROPOSITION is following, which coincides with the information in the logical selection frame. This means that the current logical hypothesis will be maintained. The selection frame of THAT$_2$ yields the information that a THING is following, and what it has to combine with to yield a PROPOSITION. Because no hypothesis about the form of the PROPOSITION following THINK has been made yet, this selection frame will cause the processor to build a second logical hypothesis:



Then when *came* is encountered the concept falls into place in the second logical hypothesis, but not in the first. The resulting hypothesis could be borne out by further lexical material, for example as in (5.46):

5.46. Who did Mary think that came for ___?

However, because in (5.40) no further lexical material is following, there is no THING slot in the logical hypothesis to which the addressee can assign the THING referred to by *who*. This means that s/he cannot build a complete PROPOSITION, which makes (5.40) unacceptable.[19]

Kempson & Matthews (1987) propose that we can account for why sentences like (5.44) are judged more acceptable than sentences like (5.42) and (5.43), by virtue of their resemblance to some other string. They propose that a sentence like (5.44) resembles a string such as (5.47) and therefore is easily rectifiable, simply by omission of *that*:

5.47. Who did Mary think came?

They argue that a sentence like (5.48) is not rectifiable, and therefore more unacceptable:

5.48. Why$_i$ do you believe the claim [that John said Bill left ___$_i$]?

However, (5.48) resembles the string in (5.49):

5.49. You believe the claim [that John said Bill left for some reason]

Without an account of why the resemblance between (5.48) and (5.49) is not sufficient for rectifying the misanalysis of (5.48), this explanation begs the question. However, on the account proposed above, we can see why sentences like (5.44) are more acceptable than sentences like (5.42) and (5.43): because (5.42) and (5.43) involve the building of two propositional forms, while the Wh-element signals that it occurs in the main propositional form but not in the

propositional form that expresses a property of a THING, there is no obvious way in which reanalysis can take place. In contrast, in (5.44), THAT is ambiguous, and COME not only specifies how it forms a PREDICATE, but also what it has to combine with to yield a PROPOSITION, so that when the addressee finds that there is no THING slot available for the THING referred to by *who*, s/he can retrieve the logical hypothesis that *that* simply signals the start of a PROPOSITION, while the logical selection frame of COME shows how this PROPOSITION should be formed.

5.4. Conclusions.

In this chapter, I have proposed an account of sentence processing, in which logical hypotheses are built on the basis of information concerning the ways in which concepts can combine to form well-formed formulae in the language of thought. This account can explain sentence input processing in terms of the interaction of input and context, guided by the principle of Relevance, and no autonomous parser is necessary. Although a lot more work needs to be done on the exact nature of the logical selection frames of concepts, the approach presented here sheds new light on a number of processing questions.

That this is a fruitful approach is shown by the fact that it can account for findings concerning ambiguous and 'garden-path' sentences. It can also account for findings which have presented problems to other proposals, such as Tyler & Warren's (1987) findings concerning globally and locally syntactically disrupted sentences, and multiple centre-embedded sentences. Moreover, it leads to a different way of looking at filler-gap dependencies.

General conclusions.

This thesis started out by looking at two possible views of the relation between grammar and the general cognitive system. On the one hand, there is the view that the grammar is a cognitive subsystem which accounts for the structure of language, whose vocabulary and operations are defined independently of the general cognitive system, and account for the structure of language. On the other hand, there is the view that the structure of language is explained by basic principles of the general cognitive system as a whole.

A lot of psycholinguistic work on sentence processing has been motivated by the view of the grammar as mental and primitive. Because syntax plays a central role within linguistic theories, many psycholinguists have assumed that there is an autonomous syntactic parser. However, the view of the grammar as 'psychologically real' is not supported by independent psycholinguistic evidence. Moreover, when we look at experimental findings concerning sentence processing, it turns out that the evidence does not unequivocally support a syntactic parser, and that the findings can be explained when we look at the role that pragmatic processes play in language comprehension.

The model presented here is premised on the hypothesis that the comprehension process is driven by pragmatics, and is aimed at computing propositional forms in accordance with the principle of Relevance. This account gives rise to a different view of how we can explain the structure of natural language sentences. The structure of natural language sentences can be explained, not by basic principles of the general cognitive system as a whole, but rather by looking at the relation between the structure of natural language and the structure of the language of thought. On this view the structure of natural language sentences is an (often incomplete) reflection of the structure of the language of thought. This means that the structure of language of thought sentences is basic, rather than the structure of natural language sentences, and that what makes a natural language sentence a possible sentence is whether it maps onto a logical form which can be completed into a well-formed proposition in the language of thought, in accordance with the principle of Relevance. Linguistic form then is constrained by the propositional form that it reflects, so that if a linguistic input does not map onto a well-formed propositional form it will not be acceptable. This shifts the focus of study from the linguistic input to the propositional form underlying

this input. Although this move may seem to make our investigations far more difficult, we have seen that Jackendoff (1983) proposes a number of basic conceptual categories whose combination into well-formed formulae is constrained by their meaning. Furthermore, these categories are supported by independent evidence. Adopting these categories gives us the beginnings of a principled account of how the language of thought is structured, while linguistic evidence can help us to develop such an account.

The proposal that information concerning conceptual structure is stored under individual concepts shows us a way in which this information is usable during sentence comprehension. It shows us how addressees can build anticipatory logical hypotheses about the overall propositional form of the utterance, which constrain the interpretation of that utterance. As we have seen, Relevance theory proposes that these logical hypotheses form a scale of implications, which either give access to a context in which further hypotheses will yield contextual effects (background implications), or which give rise to contextual effects in their own right (foreground). This proposal gives us a functional explanation for why a propositional form can be linguistically realized in different ways: different word-orders give rise to different scales of implications. While in one linguistic realization an implication may function as a background implication, in another it may function as a foreground implication, thereby giving rise to different contextual effects.

As we saw in section (1.1), one of the arguments against functional explanations of language is that there are innumerable local ambiguities in natural language, although their exclusion would facilitate parsing. However, given the account presented here, it turns out that this is not a valid argument. As we saw in section (5.2.1), even in experimental settings only one analysis of a structurally ambiguous input will be accessible to the subject, so that it does not matter that the input is, considered as a sentence, ambiguous. That this may result in the subject being 'garden-pathed' is not due to the ambiguity of the input per se, but rather to the fact that the test sentences are not acts of ostensive communication. In the case of 'garden-path' sentences the experimenter is not accommodating the choice of sentence to the processing needs of the subjects, but rather s/he does exactly the opposite. In normal ostensive-inferential communication the communicator aims at optimal Relevance, which means that s/he will choose the utterance which

accommodates the addressee's needs best. This means that the communicator will only utter an ambiguous sentence (unless making a joke), when s/he thinks that the addressee will be able to recover the intended interpretation for at little processing effort as possible (which excludes reanalysis). Of course, the communicator may not in fact be optimally relevant, and cause the addressee to go for the wrong interpretation. However, because communicators are also addressees, they can anticipate what logical hypotheses the addressee is going to make, and structure her/his utterance accordingly, so that people are rarely aware of ambiguity during on-line processing.

This way of looking at the interaction between communicator and addressee forces us to question the way in which psycholinguistic experiments are often conducted. As we have seen, when test sentences are presented in isolation, they do not yield any contextual effects. Moreover, although subjects will compute the logical form which involves least processing effort, this cannot be completed into a propositional form, because, for example, no reference can be assigned, so that the linguistic input cannot be fully interpreted. This means that presenting test sentences in isolation does not reflect normal utterance interpretation. Moreover, if information processing is driven by the search for Relevance, as proposed by Relevance theory, we should ask ourselves what the effect is of how experimental subjects interpret their tasks. It may well be that different interpretations of what they are doing a particular experimental task for, has an effect on how subjects actually process the experimental materials.

As we saw in the first chapter, researchers have argued against a functional explanation of language on the grounds that there are constraints on linguistic structure which do not facilitate sentence processing, and even make processing more difficult. However, this argument presupposes that we can say what does and what does not facilitate sentence processing in the absence of a psycholinguistic theory of sentence processing. By actually looking at what is involved in processing some of the structures ruled out by linguistic constraints, a different picture emerges. In section 5.3, we saw that we can account for the unacceptability of some structures involving Wh-movement simply by looking at what is involved in building the logical hypotheses resulting from them, rather than by postulating that a specific constraint is at work. This renders the claim that removing the constraints would facilitate processing an empty claim: the structures cannot be acceptable, because they give rise to incomplete

propositional forms in the language of thought. Although we have only looked at a processing interpretation of two constraints proposed by linguists, the finding that we can explain the unacceptability of the structures without the need to invoke special constraints, shows that the view presented here promises to improve our understanding of the comprehension process.

Although a lot of work remains to be done, the model presented here gives us an account of sentence input processing in which form and meaning go hand in hand to guide the addressee to the intended interpretation.

Footnotes Chapter 1.

1. Example due to N.V. Smith (1989).
2. I will substantiate this claim in the rest of the thesis.
3. In chapter 5, I will give an alternative explanation in terms of processing difficulties of why sentences like (1.8) are judged unacceptable.
4. According to Sperber & Wilson (1986), this process does not only apply to logical forms recovered from the linguistic input, but also to 'assumption schemas', schemas which can be used to build complete assumptions on the basis of contextual information. However, these 'assumption schemas' are also incomplete logical forms, not different in kind from incomplete logical forms recovered from a linguistic input, so that the process of enrichment can be viewed as a 'domain specific' process, solely applying to incomplete logical forms, turning them into fully propositional forms.
5. Sperber & Wilson (1986) say about this that:

   "We may assume that the memory of the deductive device has a limited, indeed a rather small capacity, so that no extensions beyond that capacity are possible. The maximal contexts are therefore those which, in view of their size, cannot be extended further." (Sperber & Wilson, 1986, p.261, footnote 7).
6. For a range of examples supporting this claim, see Sperber & Wilson, 1986, pp.188-191).
7. In chapter 4, the details of this proposal will be discussed.

Footnotes Chapter 2.

1. I have enclosed most of the interpretations of experimental findings and conclusions in the form of direct quotes, so that there could be no doubt that the interpretations I criticize are the authors' own conclusions. This seems particularly necessary in relation to issues which have given rise to a lot of claims and counterclaims, on the basis of misrepresentation.
2. For all reduced plausible sentences in appendix I of Rayner et al. (1983), a plausible continuation can be found easily on a main clause reading.
3. Table 4 of Rayner et al. (1983, p.365) shows an increased mean fixation duration (in msec.) for the fixation prior to disambiguation for the unreduced plausible sentences (e.g. 2.4c), compared to the other sentences:

   Table 4

	1	2	3
reduced plausible	209	213	222
reduced implausible	198	208	209
unreduced plausible	197	220	234
active implausible	195	207	209

This could be explained by the extra processing involved in recovering the extra assumptions, needed to accommodate the restricted relative.

4. According to Altmann & Steedman (1988), Crain & Steedman's result was only a rather slight effect. They note that this 'sense-semantic' effect "*turns out to be comparatively hard to manipulate by comparison with the referential effects that [they] discuss...*" (Altmann & Steedman, 1988, p.198). It should be noted, however, that the examples in (2.7) involve the likelihood of teachers teaching vs. children teaching, i.e. although it may not be likely that children teach (in view of our beliefs about the world), it is not impossible:

   The children taught the dog to stand on its back paws.

   These examples then are more similar to Rayner et al.'s examples involving the plausibility of florists sending flowers vs. performers sending flowers, than to Bever's examples, which involve the belief that inanimate objects cannot be agents of actions. What may play a role in these findings may be a sliding scale from a relatively weak belief about the world (e.g. performers receiving rather than sending flowers), via a stronger belief about the world (e.g. that children are taught rather than teach), to a 'higher order' belief, or knowledge about what kinds of objects can be arguments of what verbs (e.g. animate vs. inanimate).

5. This question could be tested empirically, by setting up an experiment in which sentences of the types (2.15) and (2.16/2.17) are presented in context, as well as in isolation.

Footnotes Chapter 3.

1. It is often not clear whether it is assumed that subcategorization frames represent syntactic information or whether it is assumed that they represent predicate-argument structure of a more semantic nature.

2. I have relied on the intuitions of native speakers concerning the two readings of 'consult'. Moreover, both readings are given in the Longman Dictionary of Contemporary English (1978), and Van Dale Groot Woordenboek Engels-Nederlands (1984).

3. Clifton et al. do not say whether these reaction times are significantly faster or not. However, even if the difference in reaction times is not significant, the results still do not support the Clifton et al. view, because they are looking for significantly faster reaction times for the congruous verbs, as opposed to the incongruous verbs.

4. Implicit arguments will be discussed in more detail in the next chapter.

5. At least, according to the native speakers that I have consulted.

Footnotes Chapter 4.

1. In the rest of this chapter, it will turn out that the picture sketched here in relation to verbs will have to be refined.

2. A problem that remains to be explained is how children learn which constituents that co-occur with a verb are arguments of the verb and which are not. However, this is a problem that has to be addressed by any view of how verbs are semantically represented:

it is not resolved by adopting the view of verb representation as proposed by Pinker, nor is it resolved by adopting a 'monadic concept' view of verbs.

3. I will disregard further uses of verbs like *run* such as in *She ran the show.*

4. One possible explanation might be that the patients have difficulty in relating the different entities involved in the action in the picture to the different argument slots in the semantic representation of the verb. However, this is mere speculation.

5. Judgments concerning the acceptability of (95a) differ. It may well be that in a setting where something is discussed regularly, such as 'following a lecture' among university students, the interpretation of the implicit argument in an utterance like (95a) becomes easier to recover.

6. In this section I have not accounted for all the examples that Fillmore gives. Although many of the examples can be analyzed along the same lines as I have proposed (e.g. *wait* vs. *await*, *protest/object* vs. *oppose*), a few cases remain which are problematic, such as *try* vs. *attempt*, and *promise* vs. *pledge/vow*, where the former can easily occur with an implicit argument, but not the latter.

7. In this representation I make a distinction between an 'external' argument and an 'internal' argument. This analysis reflects that the second argument is the entity affected because it is part of the act that the first argument carries out. Moreover, it shows how we can conceive of PREDICATE as a separate cognitive category (where ACT is a type of PREDICATE). It may be objected that this analysis would make the wrong predictions for VSO languages, in which the word-order seems to mirror the analyses proposed by Jackendoff and Pinker (see 5.2.2 and 5.2.3). However, when we look at a VSO language such as Scottish Gaelic, it turns out that we still need PREDICATE as a separate category, as in:

   Bha iad a'ceannachd a'chota.
   Were they at buying of the coat.
   They were buying the coat.

   In this example, we see that the predicate occurs as part of a 'circumstantial' PLACE.

8. As we will see in the next chapter, this proposal can account for experimental findings by Frazier, Clifton & Randall (1983), discussed in chapter (1), Clifton & Frazier (1986), and others, which have not been explained satisfactorily.

9. As we will see in the next chapter, in the interpretation process this specification plays a role only when the addressee does not yet have a hypothesis concerning the logical form of the utterance available.

10. This means that although a THING can have an individuating property, it does not decompose into [THING] [PROPERTY]. As we will see in the next chapter, this way of conceiving of PROPERTIES modifying THINGS plays an important role in the interpretation process.

11. Because of lack of space I will continue to represent these different PROPERTIES just as PROPERTY, but the reader should bear in mind that PROPERTY slots modifying THINGS can either be filled by a PROPERTY or by a PROPOSITION.

12. These logical selection frames do not show constraints on the interpretation of the subject of a verb. I assume that the interpretation of subject-predicate relations are done in accordance with encyclopaedic information made available by the different concepts involved.

Footnotes Chapter 5.

1. To distinguish between logical selection frames and logical hypotheses, I will represent logical hypotheses as trees of labelled nodes, rather than in linear notation, which will be reserved for selection frames. I will continue to represent structured concepts as trees as well.

2. When a sentence like *The girl is in the room* is processed in isolation, for example, in a psycholinguistic experiment, or, as is the case here, as an example, no referent will be found. However, in those situations the relevance of the linguistic input does not lie in its semantic content, and therefore it is not, properly speaking, a case of verbal or written communication. As Sperber & Wilson say:

   "Verbal behaviour proper begins when an utterance (...) is manifestly chosen by the speaker for its semantic properties. ...verbal communication proper begins when the speaker is recognized not just as talking, not even just as communicating by talking, but as saying something to someone." (Sperber & Wilson, 1986, p.178).

3. Unfortunately, it falls outside the scope of this thesis to look at tense and aspect.

4. I will leave out optional conceptual slots (such as PROPERTY modifying GIRL in this logical hypothesis), when they have not been utilized, to limit the space taken up by the representation of the logical hypotheses.

5. This analysis is supported by the occurrence in Scottish Gaelic of 'prepositional pronouns', lexical items which express a PLACE or PATH involving a pronoun, e.g. the preposition *air* (on) gives us:

   orm - on me oirre - on her orra - on them
   ort - on you oirnn - on us
   air - on him oirbh - on them

6. Again, I will leave out optional slots when it is clear they are not being used, because of lack of room on the page. However, they are still there in the representation.

7. In fact, the 'ing'-form will give access to two logical selection frames, the one given here, and one which gives *watching* as a property. The addressee will recover both and make a choice between them.

8. It falls outside the scope of this thesis to discuss the nature and representation of proper names. I assume here that Joyce stands for an instance of a THING with that name.

9. In fact *said* will cause two logical selection frames to be accessed: one in which it is an ACT and one in which it is a circumstantial PLACE. We will look at the disambiguation of cases like this in detail in the discussion of (5.5b).

10. We can think of accessibility in terms of 'activation': when a concept or conceptual slot is accessed it receives activation, thereby becoming more accessible, but when new concepts or

conceptual slots are accessed activation on the earlier ones fades away. This proposal means that we cannot equate accessibility with 'having been postulated most recently' per se, because two conceptual slots of the same type may have the same level of activation if they are further up-stream in a logical hypothesis, even though one will have been postulated more recently than the other.

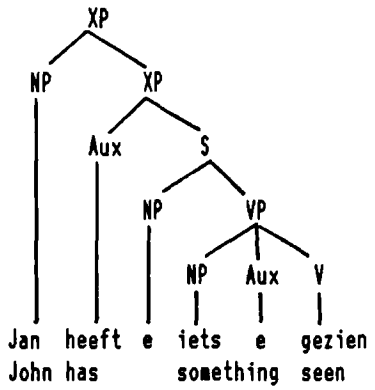
11. I'll illustrate this with two logical hypotheses, although *jog* actually maps onto (at least) four concepts, as in: (1) *He jogged my arm, spoiling my drawing*; (2) *The carriage jogged along the road*; (3) *Jay jogged a mile*; (4) *Jay jogs to work.*

12. Again RACE will actually map onto a number of concepts, and logical selection frames, but I will only discuss those that are relevant for this example, i.e. the past and passive readings of RACE that occur in (5.5b).

13. Examples due to N.V. Smith.

14. As we will see later in this section, this does not mean that they function in exactly the same way.

15. Frazier & Flores d'Arcais (1989) argue that for Dutch simple sentences, the processor postulates a structure in which the finite verb is moved form the end of the verb phrase to the complementizer position. Some other constituent is then preposed in front of the verb. Based on this Frazier & Flores d'Arcais argue that the main clause of every declarative Dutch sentence begins with a filler, a constituent that has been moved from some other position in the sentence. Because of this, they argue that the first NP is recognized as a filler, and is assigned to a gap in accordance with the Active filler strategy, giving rise to structures like:



Verhagen (1986) points out that the proposal that Dutch structure involves this kind of movement of NPs and other constituents runs into a number of problems, for which he argues *"a consistent and general solution (...) is not readily at hand within [the GB-] framework."* (Verhagen, 1986, p.75). It falls outside the scope of this thesis to discuss and evaluate Verhagen's arguments. However, a problem that can be pointed out is that Frazier & Flores d'Arcais's proposal entails that processing a Dutch sentence like *Jan heeft iets gezien* is quite different from processing an English sentence like *John has seen something*, which does not involve postulating that *John* and *something* have been moved. This makes processing Dutch look like a more complicated business than processing English. However, on the view that the linguistic input maps onto conceptual structure, we can account for processing Dutch and English in a unified way.

16. However, if *that* is interpreted as a relative pronoun, why do we not get a relative pronoun interpretation with structures as in (5.19a)?

    5.19a. *The girl with that I was talking ...

    An alternative explanation could be that the unacceptability of (5.19a) is due to the fact that *that* can also be a demonstrative, signalling that a spacially distant THING is at stake, as in: *The girl with that big dog ....* This means that on the view that *that* can occur as a relative pronoun, on encountering *that*, the addressee has two possible THINGS to fit into the logical hypothesis, relative pronoun *that* and demonstrative *that*. Since there is nothing in the logical hypothesis to signal to the addressee that a proposition is at stake, this means that the addressee would initially be garden-pathed. By using *who/whom* no such possibility for garden-pathing exists. This means that a communicator aiming at optimal relevance can only use *who/whom*. Some support for this proposal comes from Dutch. In Dutch, we find *die* which can occur as a relative pronoun (both subject and object) and as a demonstrative (that), but which does not occur as a complementizer. We also find *wie* (who) which can occur as an object relative and as an interrogative. This means that we get relatives such as:

    De jongen wie/die ik dit briefje gaf...
    The boy who I this note gave
    The boy who I gave this note...

    De jongen die/*wie gisteren belde...
    The boy who yesterday phoned...
    The boy who phoned yesterday...

    However, in the case of Dutch sentences like (5.19), we find that only *wie* can occur, and not *die*:

    De jongen met wie ik aan het praten was ...
    The boy with whom I at talking was...
    The boy with whom I was talking...

    * De jongen met die ik aan het praten was ...

    This cannot be due to *die* being a complementizer rather than a relative pronoun, because it does not occur as a complementizer in Dutch. However, because it does appear as a demonstrative, as in:

    De jongen met die leuke glimlach...
    The boy with that nice smile...

    using *die* in Dutch sentences like (5.19), causes the addressee to garden-path in the same way as set out above for English sentences.

17. Unfortunately, no experiments using the same paradigm but involving Wh-questions have been reported in the literature (as far as I know).

18. According to the native speakers that I have consulted.

19. Some extra support for this explanation, comes from the finding that the native speakers that I have consulted say that (1) can only be interpreted as (1a), and not as (1b), the opposite to the preferred reading of (5.31a):

1. Which patient did the nurse bring a doctor?
1a. Which patient did the nurse bring ____ a doctor?
1b. ? Which patient did the nurse bring a doctor ____?

Since the DOCTOR is not an accessible instance, it cannot be assigned to the THING1 slot, but has to be assigned to the THING2 slot, which means that only the THING1 slot is available for PATIENT. Since PATIENT is not an accessible instance either, the resulting question is considered to be very awkward.

20. Although this proposal differs from most other explanations for why sentences like (5.40) are unacceptable, it could be tested by setting up an experiment in which the different sentences were compared, i.e. (5.40) without *that*, (5.40) as it stands, and (5.41).

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